SFIM-AEC-RP-CR-97006

U.S. ARMY ENVIRONMENTAL CENTER

Tooele Army Depot

Revised Final Remedial Investigation Addendum Report for Operable Units 4, 8, and 9

Volume I

February 1997

Rust Environment and Infrastructure
Grand Junction, Colorado 81506

Prepared for
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland 21010-5401
under
Contract No. DAAA15-90-D-0007

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS None
2a. SECURITY CLASSIFICATION AUTHORITY 2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	3. DISTRIBUTION/AVAILABILITY OF REPORT Unlimited Distribution
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S) SFIM-AEC-RP-CR-97006
6a. NAME OF PERFORMING ORGANIZATION Rust Environment & Infrastructure 6b. OFFICE SYMBOL (if applicable) N/A	7a. NAME OF MONITORING ORGANIZATION U.S. Army Environmental Center
6c. ADDRESS *(City, State, and ZIP Code)* 743 Horizon Court, Suite 240 Grand Junction, CO 81506	7b. ADDRESS *(City, State, and ZIP Code)* ATTN: SFIM-AEC-RP Aberdeen Proving Ground, MD 21010-5401
8a. NAME OF FUNDING/SPONSORING ORGANIZATION USAEC 8b. OFFICE SYMBOL (if applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER DAAA15-90-D-0007
8c. ADDRESS *(City, State, and ZIP Code)* Aberdeen Proving Ground Edgewood, MD 21010-5401	10. SOURCE OF FUNDING NUMBERS Program Element No. / Project No. / Task No. / Work Unit Accession No.

11. TITLE *(Include Security Classification)*
Revised Final Remedial Investigation Addendum Report for Operable Units 4, 8, and 9, Tooele Army Depot

12. PERSONAL AUTHOR(s)
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13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Revised Final	From 9/28/91 to 2/19/97	February 1997	4,000 (Approx.)

16. SUPPLEMENTARY NOTATION

17. COSATI CODES

FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS *(Continue on reverse if necessary and identify by block number)*
RI Addendum; Operable Units 4, 8, and 9, Tooele Army Depot, Utah

19. ABSTRACT *(Continue on reverse if necessary and identify by block number)*

This revised final report presents the results of previous investigations as well as the results of the Phase I and Phase II RI sampling and analysis for 11 SWMUs within three operable units at Tooele Army Depot (TEAD). TEAD is a National Priorities List (NPL) site under CERCLA. This requires that a Remedial Investigation/Feasibility Study (RI/FS) must be performed. The Phase I and Phase II RI was designed to (1) fill data gaps identified from previous investigations, (2) determine the nature and extent of contamination, and (3) estimate risks to human health. The estimates of risk to the environment were assessed in a separate document, the *TEAD Site-Wide Ecological Risk Assessment Report.* This report presents the results of the RI studies in four volumes. Volume I is the RI Addendum Report and Volumes II, III, and IV are appendices of supporting information.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☐ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION Unclassified

22a. NAME OF RESPONSIBLE INDIVIDUAL	22b. TELEPHONE (Include Area Code)	22c. OFFICE SYMBOL
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SFIM-AEC-RP-CR-97006

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EXECUTIVE SUMMARY

Tooele Army Depot (TEAD), formerly referred to as Tooele Army Depot—North Area (TEAD-N) is a National Priorities List (NPL) site under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). A Remedial Investigation/Feasibility Study (RI/FS) is required to be performed for NPL sites. There are 7 Operable Units (OUs) containing 17 solid waste management units (SWMUs) at TEAD-N that are under CERCLA. Rust Environment and Infrastructure (Rust E&I), under a U.S. Army Environmental Center (USAEC) contract (Contract No. DAAA15-90-D-007, Task Order 0003), was tasked with conducting the RI/FS for TEAD-N. This RI/FS is being conducted in accordance with the requirements of a Federal Facilities Agreement (FFA) among the U.S. Environmental Protection Agency (USEPA) Region VIII, the State of Utah Department of Environmental Quality (UDEQ), and Tooele Army Depot (TEAD). The FFA established the appropriate regulatory requirements and schedule for completing the RI/FS. As part of the RI/FS, Rust E&I prepared and submitted the *TEAD-N Final Remedial Investigation Report for Operable Units 4-10* (Rust E&I 1994a), which presents the results of a Phase I field investigation program conducted in the summer of 1992. On the basis of the conclusions and recommendations within the report and comments received from USEPA and UDEQ, it was determined that data gaps still existed and additional work was required for 11 of the 17 SWMUs located in 3 OUs. Those six SWMUs found to have sufficient data following Phase I were carried through the FS process to the Record of Decision (ROD) for four of the seven OUs. The Phase II field investigation, designed to fill the data gaps for 11 SWMUs identified on the basis of the Phase I results, was conducted from June through August 1994. Additional Phase II investigations were conducted in November 1995 to address data gaps remaining at 3 of the 11 SWMUs.

In 1993, TEAD was placed on the list of facilities scheduled for Base Closure and Realignment (BRAC). Realignment activities began in October 1993 and are scheduled to be completed in June 1997. Under BRAC, the vehicle and equipment maintenance and storage functions were transferred to the Red River Army Depot, Texas. Conventional ammunition storage will continue to be performed at TEAD-N. Portions of the CERCLA OUs have been included in the BRAC portion of TEAD-N. Interim leasing of several buildings within the Maintenance Area portion of the BRAC parcel to private businesses has begun. In October 1996, the facility referred to as Tooel Army Depot—South Area was redesignated the Deseret Chemical Depot, thus making the "North Area" distinction unnecessary. This document, primarily prepared pior to the name change, still refers to TEAD-N throughout.

This *Final Remedial Investigation Addendum (RIA) Report for Operable Units 4, 8, and 9* details the Phase II investigation objectives, the technical approach and procedures used, the results of previous and Phase II field investigations, an evaluation of the nature and extent of contamination, an assessment of data quality, the determination of risks to human health, and the conclusions and recommendations. A site-wide ecological assessment was conducted on a facility-wide basis to assess risks to the environment. The results of that study were recently reported in a separate document, the *Final TEAD-N Site-Wide Ecological Risk Assessment Report* (Rust E&I 1996). The findings from the ecological assessment and the Phase II RI

study will subsequently be used in the completion of the FS where various remedial-action alternatives will be screened, analyzed, and recommended for each of the three OUs.

The OUs and associated SWMUs that are the subject of this report are shown in Table ES-1.

Table ES-1. Operable Units and SWMUs, Phase II RI

Operable Unit	SWMU No.	Site Name
4	31	Former Transformer Boxing Area
	32	PCB Spill Site
	35	Wastewater Spreading Area
8	6	Old Burn Area
	7	Chemical Range
	13	Tire Disposal Area
	22	Building 1303 Washout Pond
	23	Bomb and Shell Reconditioning Building
	36	Old Burn Staging Area
9	8	Small Arms Firing Range
	40	AED Test Range

Work plans for the Phase II data gap sampling at OUs 4, 8, and 9 were prepared and submitted in the fall of 1993. These plans provided the details of the proposed field investigation activities for each of the 11 SWMUs. Activities included additional surface and subsurface soil sampling and analysis, geophysical surveying, and groundwater sampling. Additionally, a Letter Work Plan was prepared and submitted in the fall of 1995 to provide details of sampling for three SWMUs that addressed remaining data gaps in surface and subsurface soils. Activities in 1995 included surveys for unexploded ordnance (UXO), explosive ordnance debris, and propellant as well as additional surface and subsurface soil sampling.

Surface and subsurface soil samples were collected using several methods, including soil borings, test pit excavations, and hand auger sampling. In addition, one water supply well was sampled. Chemical analyses were performed by a USAEC-approved and State of Utah-certified laboratory, using USAEC performance-demonstrated methods. All analytical data were screened and validated through the use of the USAEC Installation Restoration Data Management System (IRDMIS), internal data screening tools, and an independent third party

specializing in data validation. Additional screening was performed according to USEPA risk assessment guidance to determine chemicals of potential concern (COPCs) for each of the SWMUs. The analytical suite selected for each sample was based on a review of all previous investigation results and past facility activities reported for each SWMU. All valid and Phase II results were combined prior to screening.

The screened data were evaluated to determine the nature and extent of any contamination at each SWMU. Following the nature-and-extent analysis, a quantitative human health risk assessment was performed to determine whether any adverse effects to human health could occur as a result of past activities. Potential adverse effects to the local ecology and environment are addressed in the *Final TEAD-N Site-Wide Ecological Risk Assessment Report* (Rust E&I 1996).

The following summarizes the findings of this RIA for each OU.

OPERABLE UNIT 4

OU 4 consists of three sites located in the eastern part of TEAD-N: the Former Transformer Boxing Area (SWMU 31), the PCB Spill Site (SWMU 32), and the Wastewater Spreading Area (SWMU 35). SWMUs 31 and 32 are within the BRAC parcel, and the extreme eastern portion of SWMU 35 was also placed in the BRAC parcel and is being evaluated under the BRAC program. Sufficient data were collected during the Phase II RI to characterize the potential contamination, to evaluate baseline risks to human receptors, and to conduct an FS. Therefore, no further RI field investigations appear to be warranted for these three SWMUs.

Former Transformer Boxing Area (SWMU 31)

This SWMU consists of Open Storage Lot 680, which until recently, was being used as a parking area for vehicles. Prior to being used for vehicle storage, this lot was used for short-term storage of transformers that had been moved from SWMU 17. There were no reported spills or releases of PCB-contaminated oils at this site, and there was no visual evidence of spills. However, due to the potential for PCB releases from past undetected oil spills, surface soil sampling was conducted during the Phase II field investigation. Low concentrations of SVOCs were the only analytes detected and are thought to be associated with leakage of fluids from stored vehicles. The only COPCs identified at this site were carcinogenic PAHs. Human health risks are within or below USEPA criteria for all current and future land use scenarios evaluated for SWMU 31, and no further remedial investigations are recommended. The SWMU is ready to be carried forward to the FS. It should be noted that the vehicles present during the Phase II field investigation have since been removed, thereby eliminating the suspected source of SVOC contamination at SWMU 31.

PCB Spill Site (SWMU 32)

The PCB Spill Site is the location of a spill of PCB-contaminated oil on Open Storage Lot 665D, which resulted from the puncturing of two electrical transformers. The spill occurred

on an unpaved ground surface. Cleanup of the oil-contaminated soils was conducted shortly after the spill, and the soils that were removed along with some of the oil were placed in 55-gallon drums. TEAD collected composite soil samples to verify the cleanup of the soils. The composite samples indicated that low levels of residual PCBs were still present in the site soils. Calculated human health risks utilizing the existing PCB data indicated carcinogenic risk estimates would be within the USEPA target range for potential exposure to carcinogens. Because of uncertainties with the earlier data and the calculated risks within the USEPA target range, soil sampling was conducted during the Phase II field investigation to further characterize the SWMU. PCBs were not detected in surface or subsurface soils, indicating that the previous cleanup was complete. A few SVOCs in low concentrations and metals above background concentrations were found. Arsenic, cadmium, and chromium were the COPCs retained for the quantitative human health risk assessment. Calculated risks to human health were within or below the USEPA criteria; therefore, no unacceptable human health risks were associated with this SWMU. No further remedial investigations are recommended. The SWMU is ready to be carried forward to the FS.

<u>Wastewater Spreading Area (SWMU 35)</u>

SWMU 35 consists of an area where wastewater from an on-site housing area was allowed to discharge, and it contains two unlined ditches leading to a ravine and a spreading area. This SWMU was identified from historical aerial photographs, which indicated the presence of liquids in ditches, trenches, a ravine, and the spreading area below the ravine. The Phase I investigation identified the possibility of pesticide and metals contamination at this SWMU. During the Phase II field investigation, surface and subsurface soils samples were collected and analyzed for metals and pesticides. In addition, a water supply well (WW-1) was sampled to address the possible migration of soil contaminants to the groundwater. No analytes above the MCLs were detected in the groundwater sample. Pesticides and metals above background concentrations were identified in both surface and subsurface soils. Arsenic, delta-benzenehexachloride, alpha-chlordane, gamma chlordane, endrin, heptachlor and heptachlor epoxide were identified as COPCs. The quantitative human health risk assessment indicated that all scenarios, except for a hypothetical future resident within an area of concern associated ditches west of the stable area, fall within or below the USEPA target range and hazard index goal for carcinogenic and chronic noncarcinogenic risks, respectively. Risk estimates for hypothetical future residents within the area of concern exceed the upper bound criteria due primarily to ingestion of produce from contaminated soils at SWMU 35. No further remedial investigations are recommended. The SWMU is ready to be carried forward to the FS.

OPERABLE UNIT 8

OU 8 is made up of six SWMUs generally located in the southwestern portion of TEAD-N: the Old Burn Area (SWMU 6), the Chemical Range (SWMU 7), the Tire Disposal Area (SWMU 13), Building 1303 Washout Pond (SWMU 22), the Bomb and Shell Reconditioning Building (SWMU 23), and the Old Burn Staging Area (SWMU 36). In addition to the SWMU-specific evaluations, the potential for risk to human health from the consumption of beef from cattle that grazed on land within this OU was evaluated. Sufficient data were

collected during the Phase II RI to characterize the potential contamination, to evaluate baseline risks to human receptors, and to conduct an FS. Therefore, no further RI field investigations appear to be warranted for these six SWMUs.

Old Burn Area (SWMU 6)

The Old Burn Area (SWMU 6) is located in the south-central portion of TEAD-N and consists of a gently sloping grassy area with a bermed revetment located in the eastern part of the SWMU. The area was used for munitions testing and was also used for the burning of wooden boxes and crates on the ground surface and in shallow trenches. All of the former trenches and disturbed areas have been filled, graded, and revegetated since use of the area for testing and burning was discontinued. Previous investigations identified several target areas for locating these trenches through the use of geophysical surveys. The Phase I Investigation further identified a number of geophysical anomalies thought to represent buried trenches. Test pits excavated in the areas of the anomalies encountered buried debris and zones of burned material, confirming that most of the anomalies did represent former trenches. Metals above background concentrations and explosives were detected in the subsurface soils collected from the test pits. Surface soil samples during Phase I collected in the shallow drainage gullies on the northern side of the SWMU contained low levels of explosives. During the Phase II investigation, additional surface and subsurface soil samples were collected. Test pits were located to further investigate the geophysical anomalies identified during the Phase I geophysical survey, and the surface soils samples were located to determine the horizontal extent of the low level surface explosives contamination. Buried metal debris was found in a number of test pits and elevated metals were detected in the corresponding soil samples. An explosive, RDX, was detected in one subsurface sample. The explosives identified during Phase I sampling were not confirmed in the Phase II surface soil samples in the drainage gullies. Also collected during the Phase II RI were surface soil samples throughout the SWMU and in four background locations for dioxins/furans analysis. In addition, burn horizons in subsurface soils of former trenches were also collected for dioxins/furans analysis. Results indicate that low levels of both dioxins and furans are present throughout the SWMU. Aluminum, antimony, arsenic, chromium, copper, iron, lead, thallium, and zinc were COPCs retained for the quantitative human health risk assessment after the evaluation and screening of the data. The explosive 1,3,5-trinitrobenzene was also retained for a hot spot evaluated in the revetment portion of SWMU 6. Estimated risks to human health under current land use scenarios are within or below USEPA criteria. For the revetment area, the future on-site resident (adult and child) had estimated carcinogenic risks within USEPA criteria but noncarcinogenic hazard indices exceeding unity (one) due primarily to ingestion of copper in produce raised in the area of concern. A hot spot evaluation was also conducted in the revetment area for a small area of lead contamination. Results indicate that lead contamination poses a risk in the construction worker scenario. USAEC has proposed doing additional surface sampling in the revetment area to further define the extent of lead contamination as part of the FS Process. No other scenarios had risks exceeding USEPA criteria at SWMU 6. No further remedial investigations are recommended. The SWMU is ready to be carried forward to the FS.

Chemical Range (SWMU 7)

The Chemical Range was used for the testing of flares, smoke grenades, smoke pots, riot control munitions, and other related munitions. Prior to 1991, two open trenches were present at the east end of the range, referred to as the Firing Point. These trenches were used for the disposal of debris from the explosives testing in the area. In a previous investigation, the results of sampled soil from the bermed soils adjacent to the trenches indicated the presence of several metals in concentrations above background. At the time of the Phase I RI, the previously open trenches had been filled and the surface graded. As part of the Phase I field investigation, test pits were excavated into areas identified as target areas for trenches from geophysical anomalies. One of the former trenches was located, and buried metal debris was found. Chemical analysis of samples taken from the test pits and surface soils found anions as the only COPCs. The Phase II investigation was conducted to further characterize the disposal area at the Firing Point, to investigate an area containing an open trench located in a testing area northwest of the Firing Point, and to determine if contamination is present along the firing course and bullet stop as a result of the testing activities. Geophysical surveys were performed during Phase II to further define areas of potential buried trenches. Additional areas of potential buried metal debris were identified by the geophysical surveys and confirmed during test pit excavations. Metals above background concentrations were detected in surface and subsurface soils collected throughout the SWMU 7 area. However, the only significant concentrations were detected in the soils in the immediate vicinity of the bullet stop. Scattered low concentrations of SVOCs were also detected in several samples. However, the only COPCs retained were the metals aluminum, arsenic, beryllium, manganese, and thallium. Estimated risks to human health under all of the evaluated scenarios are within or below USEPA criteria with the exception of noncarcinogenic hazard indices for current off-site child resident, future on-site residents in the bullet stop area and the future construction worker at the northeast test area trench where the goal of unity (one) was exceeded. TEAD has submitted plans to conduct a voluntary removal action of debris in the trench to reduce or eliminate these identified risks. No further remedial investigations are recommended. The SWMU is ready to be carried forward to the FS.

Tire Disposal Area (SWMU 13)

The Tire Disposal Area consists of a large pit that resulted from previous gravel mining operations. The area covers approximately 11 acres in the southern portion of TEAD-N. Unreclaimable tire carcasses from TEAD-N vehicles had been disposed of in the pit from 1965 to 1993. During the Phase I RI, a site walk-over was conducted. It was determined that there was no evidence of other types of waste disposal at this SWMU, with the exception of wooden pallets which had been used for moving the tires. Subsequent to the Phase I field investigation, the tires were removed off site for reuse. The floor of the pit was graded smooth, and berms were pushed up to block most potential entrances to the pit. During the Phase II investigation, test pits were excavated and surface and subsurface soil samples were collected to determine if other types of waste disposal may have occurred at SWMU 13. Low concentrations of SVOCs and VOCs were detected, and metals in concentrations above background were identified. After the evaluation and screening of the data, chloromethane

and diethyl phthalate were COPCs retained for the quantitative human health risk assessment. All human health risks under current land use scenarios are below USEPA criteria, and all risks to human health under future scenarios were within or below criteria for SWMU 13. No further remedial investigations are recommended. The SWMU is ready to be carried forward to the FS.

Building 1303 Washout Pond (SWMU 22)

SWMU 22 consists of Building 1303, which was used for the sawing of munitions, and a contaminated area, which resulted from washdown operations. Washdown water from the washing of the floors at Building 1303 crossed a concrete pad to a shallow ditch, depression (pond), and an open spreading area. Phase I RI results identified elevated concentrations of explosives and metals in the ditch and pond areas. A review of the data indicated that further investigation was needed in the area between Building 1303 and the ponding area to define the horizontal and vertical extent of contamination. During the Phase II field investigation, additional subsurface soil samples were collected from soil borings to evaluate vertical extent of contamination, and surface soil samples were taken to evaluate horizontal extent of contamination. Metals above background concentrations and explosives were found in both surface and subsurface soils. The explosives were confined to the discharge ditch and ponding area of the SWMU, while the elevated metals were located primarily on the surface throughout the SWMU. Following the evaluation and screening of the analytical data, the explosive compounds 1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, and RDX were retained for the quantitative human health risk assessment. In addition, chromium was retained for subsurface soils at SWMU 22. The estimated risks under current scenarios are within USEPA criteria except for noncarcinogenic hazard indices that exceed unity (one) due primarily to potential ingestion of explosives in soil. Hazard indices for future on-site resident scenarios also exceed the USEPA goal of unity (one). Removal of soils from the stained area adjacent to the concrete pad, from the drainage from the pad to the ponding area, and from the ponding area would likely reduce risks to acceptable levels. TEAD has submitted plans to conduct a voluntary removal action of the explosive contaminated soils at SWMU 22. This removal would also address the metals contamination in the drainage area. No further remedial investigations are recommended. The SWMU is ready to be carried forward to the FS.

Bomb and Shell Reconditioning Building (SWMU 23)

Located in the western portion of TEAD-N, the Bomb and Shell Reconditioning Building (Building 1345) was used for conducting bomb reconditioning, including sandblasting and painting. Another building (Building 1343) houses a boiler used to supply hot water to Building 1345. Floor drains in Building 1345 discharged liquids from washdown operations to a ditch north of the site. Building 1345 is still used as a paint shop and on occasion is used for munitions reconditioning projects. A second discharge area receives boiler blowdown from Building 1343 through a ditch and spreading area.

During the Phase I field investigation, areas of surface staining were observed in soils adjacent to the building and the paved areas around this and the other buildings. Surface soil and

sediment samples collected contained elevated metals, SVOCs, and PCBs. Further investigation of the SWMU during the Phase II investigation was required to better define the extent of contamination resulting from wastewater discharges and to further define the horizontal spread of contamination along the perimeter of the paved area of the SWMU. Surface and subsurface soils were collected. Stained areas associated with the outfalls and discharge areas contained metals above background concentrations, SVOCs, cyanide (at low concentrations), and PCBs. Samples from the perimeter of SWMU 23 contained elevated metals and low concentrations of SVOCs. After evaluation and screening of the data, cadmium, chromium, lead, anthracene, phenanthrene, pyrene, PCB 1248, total PCBs, and total carcinogenic PAHs were the COPCs retained for the quantitative human health risk assessment. Individual areas of concern were evaluated as well as SWMU 23 as a whole. Estimated carcinogenic risks for the current land use scenarios are within or below the USEPA criteria. Future land use scenarios also had risks within or below USEPA criteria with the exception of the future on-site resident in the Building 1345 Outfall area of concern. For the residents at this area of concern, the ILCR exceeded the target range of 1E-04 and the noncarcinogenic hazard indices exceeded the goal of unity (one) from the ingestion of soils, dermal contact with soils, and ingestion of produce. No further remedial investigations are recommended. It was determined that possible consideration should be given to conducting "hot spot" removals of the stained soils in these two areas. In addition, evaluation of an area where Photo Ionization Detector (PID) readings indicated the presence of VOCs is recommended for the FS process. This SWMU is ready to be carried forward to the FS.

Old Burn Staging Area (SWMU 36)

The Old Burn Staging Area consists of a small gravel pit located just north of the Old Burn Area (SWMU 6). The pit was used for the temporary storage of materials to be burned at SWMU 6. During the Phase I field investigation, it was observed that several dark stained areas are present in the pit as the result of surface burning. In addition, several burn areas were observed to be present north of the pit. Surface soil samples were collected in both areas and were found to have elevated concentrations of metals. A geophysical survey was also conducted, and no areas of buried materials were identified. During the Phase II field investigation additional surface and subsurface soil samples were collected to determine the vertical and horizontal extent of the elevated metals concentrations in the former burn areas in the gravel pit and to the north of the pit. Metals at concentrations slightly above background were detected in surface samples, and mercury was detected in one subsurface sample. The contamination is minor, primarily associated with areas of surface contamination where burning was conducted. After the evaluation and screening of the data, barium, copper, and lead were retained as COPCs. Human health risks for current land use scenarios are within or below USEPA criteria at SWMU 36. A hot spot analysis was performed within the gravel pit and risks associated with the hot spot area were evaluated. Results for future on-site residents indicate that noncarcinogenic hazard indices exceed the goal of unity (one) primarily from ingestion of produce in the hot spot area of SWMU 36. This SWMU would also lend itself to hot spot removal action to effectively reduce future risks to acceptable level. No further remedial investigations are recommended. The SWMU is ready to be carried forward to the FS.

OPERABLE UNIT 9

OU 9 consists of two test ranges in the northwestern section of TEAD-N: the Small Arms Firing Range (SWMU 8) and the AED Test Range (SWMU 40). Sufficient data were collected during the Phase II RI to characterize the potential contamination, to evaluate baseline risks to human receptors, and to conduct an FS. Therefore, no further RI field investigations appear to be warranted for these two SWMUs.

Small Arms Firing Range (SWMU 8)

Located along the western boundary of TEAD-N, the Small Arms Firing Range has been used for training military personnel in the use of small firearms. Bermed areas behind the targets at the SWMU were sampled during the Phase I RI and found to have elevated concentrations of lead and leachable concentrations of barium, cadmium, lead, and mercury. Surface and subsurface samples were collected during the Phase II investigation across the entire SWMU to further define the horizontal and vertical extent of contamination. In November 1995, additional Phase II surface and subsurface soils sampling was conducted in an area beyond the bermed areas to evaluate potential contamination and risks associated with overshot debris. Metals at concentrations exceeding background were detected throughout the SWMU but were concentrated near the bullet stop areas. The bullet stop area was identified as an area of concern and was evaluated separately. A SWMU-wide evaluation of risk was also conducted. Aluminum, antimony, arsenic, chromium, copper, and lead were identified as the COPCs for the quantitative human health risk assessment. Estimated risks under current use scenarios were all found to be within or below USEPA criteria with the exception of the future on-site child resident where blood lead levels ranged from 16.5 to 25.5 μg Pb/dL compared to the target level of 10 μg Pb/dL. Future scenario risks were also within or below criteria with the exception of future on-site residents in the Bullet Stop area of concern where noncarcinogenic hazard indices exceed unity (one) primarily due to ingestion of produce. No additional remedial investigation is recommended. This SWMU is ready to be carried forward to the FS. Evaluation of removal options for the Bullet Stop area is recommended.

AED Test Range (SWMU 40)

The AED Test Range is a testing facility that has been used for the testing of munitions, bombs, and rocket engines. Features at the SWMU include a building foundation from a former deactivation furnace, a drop tower, several testing revetments, an open trench, and an area of craters resulting from bomb detonations. The SWMU was used occasionally for testing activities until 1995, and UXO continues to be found to exist at the SWMU. The Phase I investigation detected elevated metals and explosives contamination at the surface, and test pits inside the revetments uncovered buried munitions debris with corresponding metals and explosives contamination. Because of the variety of testing activities conducted at this SWMU, it was suspected that contaminants may be different for each testing area. To delineate the extent of contamination and further characterize the SWMU, additional surface

and subsurface soil samples were collected during the Phase II field investigation primarily through the excavation of 60 test pits. Metals at concentrations exceeding background and explosives were detected in both surface and subsurface soil. In November 1995, the entire SWMU 40 area was gridded and a walking survey by explosive ordnance disposal (EOD) specialists and Rust E&I personnel was conducted to determine the types and distribution of debris, UXO, and propellants at SWMU 40. Four grids containing propellant fragments on the surface were selected for detailed evaluation of propellant types and distribution. In addition, samples of soil beneath propellant fragments were collected and analyzed for a suite of chemicals specific to propellant compositions. On the basis of the sample results, minor amounts of contaminants appear to have leached from the propellants to the underlying soils. From all sample data evaluated for SWMU 40, arsenic, barium, lead, HMX, RDX, and 1,3,5-trinitrobenzene were retained as COPCs. A hot spot evaluation was conducted for an area containing elevated concentrations of RDX in addition to a SWMU-wide evaluation. Estimated risks to human health for all the scenarios evaluated are within or below the USEPA criteria with the exception of the future on-site residents for the hot spot area where both carcinogenic risks and noncarcinogenic hazards exceed USEPA criteria primarily from ingestion of RDX in produce. No further remedial investigations are recommended. This SWMU is ready to be carried forward to the FS. A physical risk from the presence of UXO at this SWMU still exists. This should be evaluated further during the FS. Clearance of all areas for UXO would be required prior to any land use change for SWMU 40. Further evaluation of a trench covered with metal plates is recommended. A live munition was encountered on one end of this trench during the Phase II RI and no further evaluation was conducted because of safety concerns. Experienced EOD personnel would be required to evaluate this trench.

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

Rust Environment and Infrastructure (Rust E&I) is contracted by the U.S. Army Environmental Center (USAEC), under Contract No. DAAA15-90-D-0007, to conduct a Remedial Investigation/Feasibility Study (RI/FS) for 17 solid waste management units (SWMUs) located within 7 Operable Units (OUs) at Tooele Army Depot–North Area (TEAD-N), Utah. This RI/FS is being conducted in accordance with the requirements of a Federal Facilities Agreement (FFA) between the U.S. Environmental Protection Agency (USEPA) Region VIII, State of Utah Department of Environmental Quality (UDEQ), and Tooele Army Depot (TEAD). As part of the RI/FS, Rust E&I prepared and submitted a Final RI Report (Rust E&I 1994a). On the basis of the conclusions and recommendations within the report and comments received from UDEQ and USEPA, it was determined that additional work was required for 11 of the 17 SWMUs located in 3 of the OUs. This RI Addendum (RIA) report describes the results of that additional work.

The two primary objectives of the RI portion of the RI/FS are to investigate the nature and distribution of contaminant releases within each OU and to assess the potential risk to human health and the environment posed by these releases. To provide the information and data required to meet these objectives, Rust E&I initially reviewed results of previous environmental investigations at TEAD-N and, on the basis of this review, prepared RI Work Plans that identified data-quality objectives, data gaps, data-collection strategies, and methods and procedures required to further characterize each OU. From these work plans, Rust E&I conducted a Phase I field investigation from May through July of 1992 at TEAD-N and performed subsequent sample analysis and data-evaluation activities resulting in the completion of the above referenced Final RI Report. Several data gaps, however, were found to still exist for 11 of the 17 SWMUs. Subsequently, Rust E&I conducted Phase II field investigations from June through August 1994 and during November 1995. The six SWMUs in the remaining four OUs were found to have sufficient data following Phase I and were carried through the FS process to the Record of Decision (ROD), which was approved in September 1994.

The purpose of this RIA is to summarize the results of the Phase II investigations, to present and evaluate the data collected during the Phase I and Phase II field investigations, and to provide subsequent conclusions and recommendations. Included are the results of a revised human health risk assessment, which provide an evaluation of the potential threat to human health for 11 SWMUs on the basis of previous and Phase II RI results. Results from a TEAD-N Site-Wide Ecological Risk Assessment conducted by Rust E&I, which included potential risks for each of the 11 SWMUs are presented in a separate document (Rust E&I 1996). This RIA report provides the basis for a future FS, which will utilize all available site data for the development, screening, and detailed analysis of remedial alternatives for each OU.

1.2 REPORT ORGANIZATION

The organization of this report generally follows the original format of the RI Report and the suggested format provided in *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA 1988a). This RIA is designed to supplement the previous report by providing new information gained through the Phase II investigations.

The remainder of Section 1.0 provides a history of TEAD-N and brief descriptions of the TEAD-N installation, of the OUs covered by this RIA, of previous investigations performed, and of the regulatory history leading up to the completion of this addendum to the RI Report. It also provides additional information on the physical setting of TEAD-N obtained during various investigations. Section 2.0 describes the technical approach and methodologies used to conduct the Phase II field surveys and sampling, subsequent laboratory analyses, and data evaluation. Section 3.0 discusses the methodologies used during the Phase II RI to select chemicals of potential concern (COPCs), to evaluate fate and transport characteristics, and to assess risk to human health and the environment. In addition, the methodologies used to conduct an installation-wide assessment of potential risks associated with human consumption of homegrown produce and beef within contaminated areas of TEAD-N are summarized. Sections 4.0, 5.0, and 6.0 present the Phase I and II RI results for OUs 4, 8, and 9, respectively. These sections present the following information for the SWMUs in each OU: (1) site characteristics; (2) a description of previous investigations and RI activities; (3) a contamination assessment, including an evaluation of data quality and a discussion on the nature and extent of contamination; (4) a human health risk assessment including selection of COPCs, determination of fate and transport, toxicity characteristics for the COPCs, evaluation of potential exposure pathways, and completion of a baseline risk assessment (results of an ecological risk assessment are also incorporated); and (5) conclusions and recommendations. Section 7.0 presents a summary of the conclusions and recommendations on the basis of the Phase II RI results. Section 8.0 provides the references cited in this RIA, and Section 9.0 provides a glossary of acronyms and abbreviations used throughout the addendum.

Appendices A through R are provided in Volumes II, III, and IV: A—Phase II RI Boring Logs; B—Phase II RI Test Pit Records; C—Phase II Field Investigation Photographs; D—Geotechnical Soil Testing and Classification Results; E—Surveyor's Report on Locations of Test Pits, Observation Pits, and Bunker Locations; F—Geophysical Survey Methodology and Results; G—Homegrown Vegetables Soil Testing Results; H—RI Addendum Analytical Results; I—Quality Control Samples; J—Data Quality Assessment Results; K—GWM-1 Spreadsheets and MULTIMED Modeling Output Tables; L—Estimation of Exposure Point Concentrations, Uptakes, and Exposure Model Parameters; M—Toxicity Assessment; N—Air Dispersion Modeling; O—Adult Exposures to Inorganic Lead; P—Tentatively Identified Compounds; Q—UXO/Debris Walking Survey Results for SWMU 40; and R—Bar Graphs for Distribution of Dioxin/Furan Congeners.

1.3 BACKGROUND

1.3.1 Installation Description and History

TEAD-N occupies approximately 24,732 acres of the Tooele Valley, in Tooele County, Utah. The facility is located just west of the city of Tooele, Utah, approximately 35 miles southwest of Salt Lake City (Figure 1-1).

Tooele Valley is predominantly undeveloped with the exception of the cities of Grantsville and Tooele, and scattered residential development north of Tooele. Except for Tooele, lands immediately adjacent to TEAD-N are undeveloped. Properties to the north of the facility are used for livestock grazing and limited cultivation, and properties to the west and south are used for rangeland grazing. Properties to the east include residential development immediately adjacent to TEAD-N.

The major missions of TEAD-N have included the maintenance, renovation, and storage of wheeled vehicles, and the reception, storage, issuance, maintenance, and disposal of munitions. Developed features at TEAD-N include igloos, magazines, administrative buildings, an industrial maintenance area, military and civilian housing, roads, hardstands for vehicle storage, and other allied infrastructure. Although not included as part of this RIA, the Deseret Chemical Depot, previously part of TEAD (designated the South Area (TEAD-S)), is located approximately 17 miles to the south of TEAD-N. This facility has served primarily as a facility for the storage and maintenance of bulk chemical agents and chemical weapons. A full scale facility for the destruction of these chemical agents began operating in the summer of 1996.

TEAD-N was established as the Tooele Ordnance Depot on April 7, 1942, by the U.S. Army Ordnance Department. It was redesignated as TEAD-N in August of 1962. At that time, a second facility, TEAD-S (formerly the Deseret Chemical Warfare Depot) became part of the Tooele Army Depot although the two facilities are located approximately 17 miles apart. During World War II, TEAD was a back-up depot for the Stockton Ordnance Depot and Benicia Arsenal, both located in California. It stored vehicles, small arms, and other equipment for export.

TEAD has been one of the major ammunition storage and equipment maintenance installations in the U.S., supporting other Army installations throughout the western U.S. However, the installation was realigned by the Base Realignment and Closure (BRAC) Commission. Realignment activities are ongoing with many of the previous vehicle and equipment maintenance functions being transferred to the Red River Army Depot, Texas.

Two parcels of land have been realigned by the BRAC: the Industrial Parcel and the Administrative Parcel. The Industrial Parcel contains SWMUs 31 and 32, which have been investigated as part of this RI. The Administrative Parcel is adjacent to the eastern edge of SWMU 35 but does not include the SWMU (Figure 1-2).

As a result of continuous operations since 1942, a variety of known and potential waste and spill sites have been identified at TEAD-N. Environmental evaluation of these sites began in the late 1970s and continues through the present. To date, 57 SWMUs have been identified as having released or having the potential to release contaminants to environmental pathways at TEAD-N. In October 1990, TEAD-N was added to the National Priorities List (NPL), which is regulated under the USEPA's Superfund program. As a result, 17 of the SWMUs were placed under the Superfund program. The remaining SWMUs are regulated under the RCRA program. Sixteen SWMUs, located in the maintenance area of TEAD-N, have also been placed under the BRAC program.

1.3.2 Operable Unit Descriptions

This RIA covers the 11 SWMUs contained in OUs 4, 8, and 9 at TEAD-N. All seven of the CERCLA OUs are shown in Figure 1-2 and listed in Table 1-1. The following sections describe only those OUs and associated SWMUs evaluated during the Phase II investigations.

OU 4 consists of three sites in the southeastern part of TEAD-N: the Former Transformer Boxing Area (SWMU 31), the PCB Spill Site (SWMU 32), and the Wastewater Spreading Area (SWMU 35). SWMU 31 is an open storage lot, used from about 1979 to 1980 for the temporary storage of transformers. SWMU 32 is also an open storage lot that was the location of a previous transformer oil spill. SWMU 35 is an area where wastewater from an on-site housing area was allowed to discharge into two unlined ditches leading to a ravine and a spreading area.

OU 8 consists of six sites in the southwestern portion of TEAD-N: the Old Burn Area (SWMU 6), the Chemical Range (SWMU 7), the Tire Disposal Area (SWMU 13), the Building 1303 Washout Pond (SWMU 22), the Bomb and Shell Reconditioning Building (SWMU 23), and the Old Burn Staging Area (SWMU 36). SWMU 6 is an area that was used for the testing of munitions, fuses, and propellants and the burning of crates and boxes. SWMU 7 is an area that was used for the testing of chemical and pyrotechnic-type munitions, excluding agent-filled munitions, and has been divided into three sub-areas: (1) the firing course itself, including the bullet stop; (2) the firing point at the east end, which includes two covered trenches that had been used for the disposal of munitions after testing; and (3) an open trench located northwest of the firing point. SWMU 13 consists of a large pit, which resulted from previous gravel-mining operations and which was used from 1965 to 1993 for the disposal of unreclaimable tire carcasses. SWMU 22 reportedly received washdown water from Building 1303, where sawing of munitions was conducted. SWMU 23 was used for performing external work on large munitions. SWMU 36 is a former gravel pit that was used for the staging of materials to be burned or disposed of at SWMU 6.

OU 9 consists of two sites in the western-most portion of TEAD-N: the Small Arms Firing Range (SWMU 8) and the AED Test Range (SWMU 40). Site 8 was used for training in the use of small arms. Site 40 was used for the testing of munitions and rocket engines, and for testing of the former Building 1236 Deactivation Furnace, which now consists of the foundation and three walls.

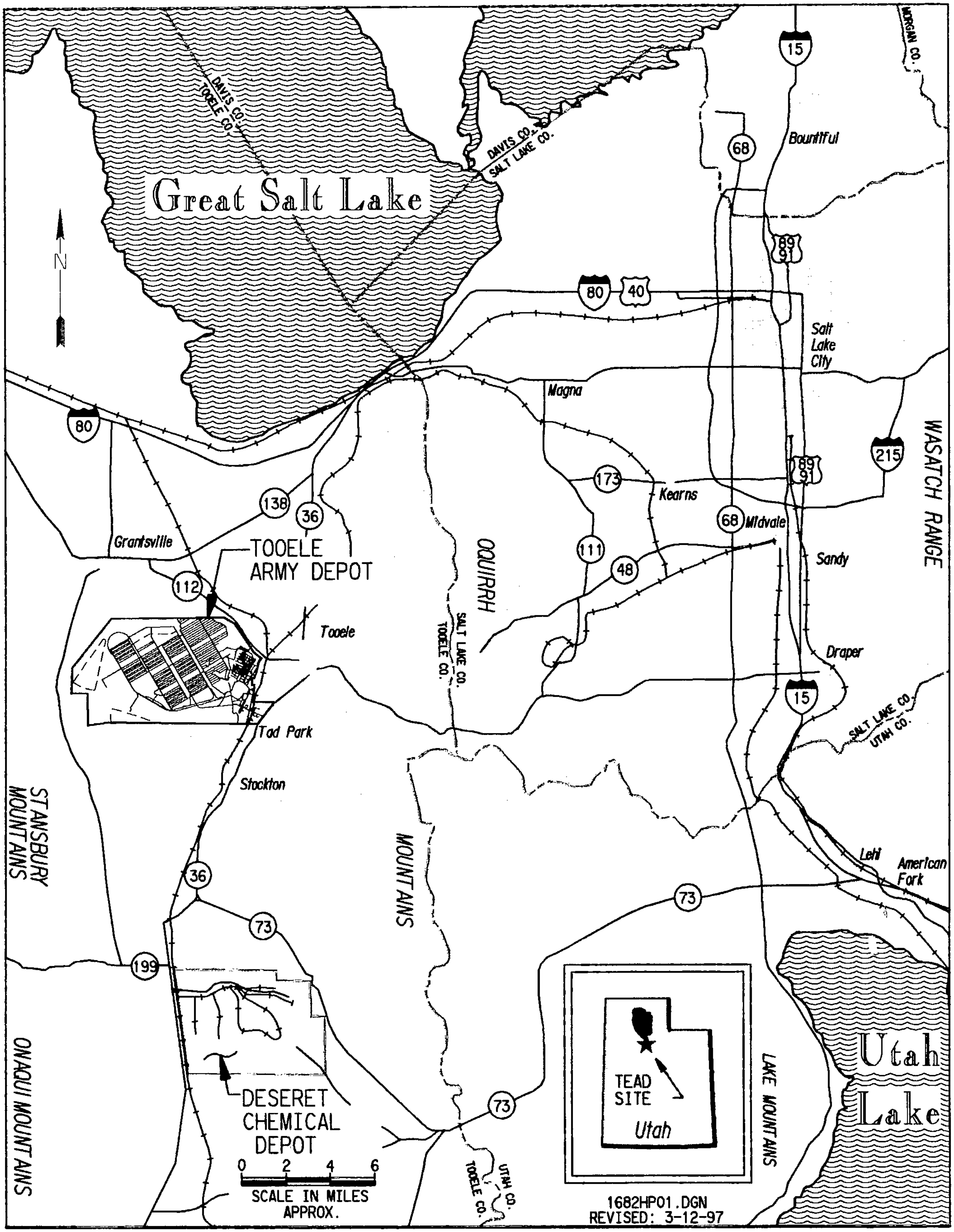


Figure 1-1. Location Map of Tooele Army Depot-North Area and Vicinity (1672HP02.DGN)

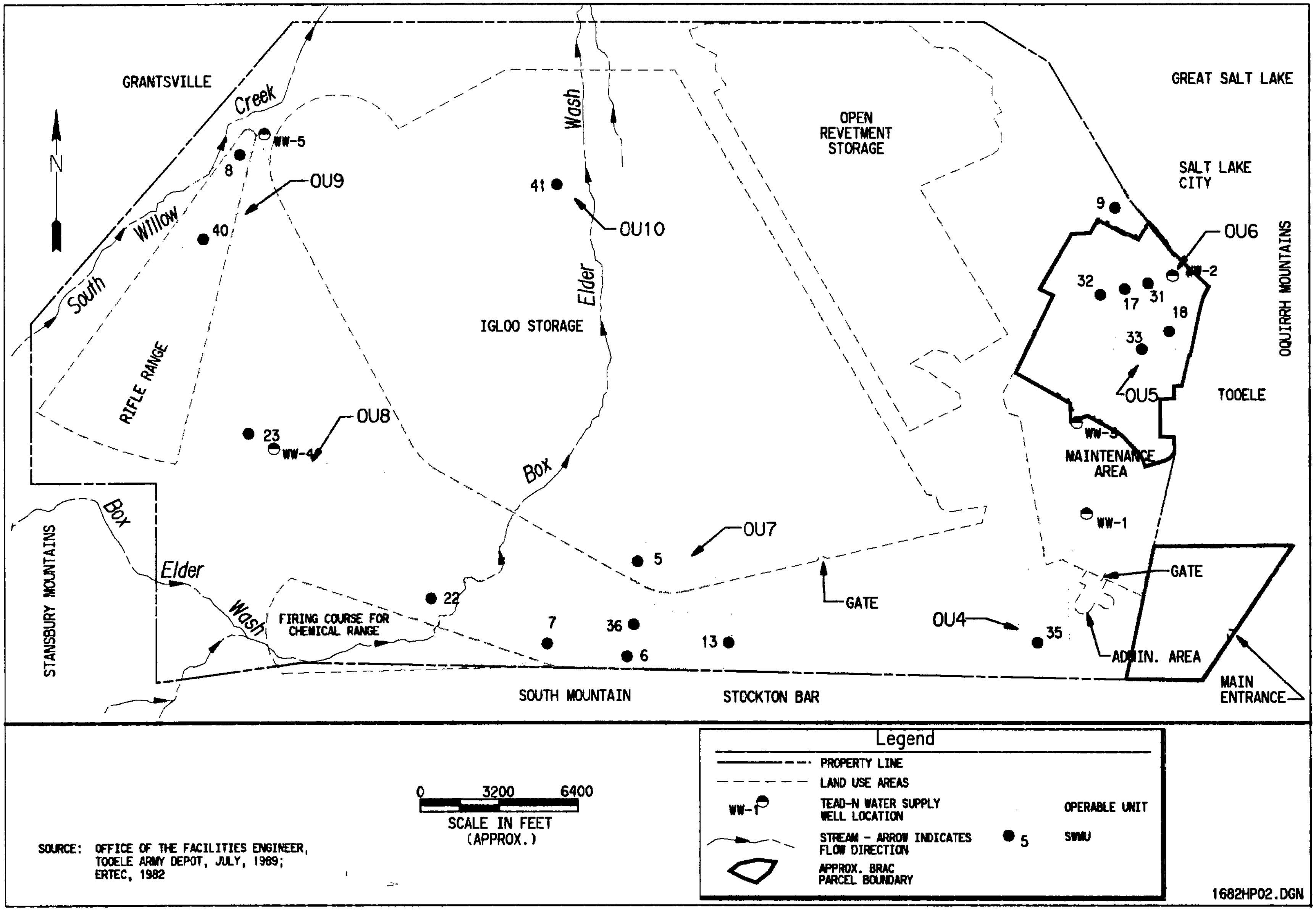


Figure 1-2. Location of OUs/SWMUs at TEAD-N

Table 1-1. The 17 SWMUs Within 7 Operable Units at Tooele Army Depot-North Area

Operable Unit	SWMU[a] No.	Site Name
4	31	Former Transformer Boxing Area
	32	PCB Spill Site
	35	Wastewater Spreading Area
5	17	Former Transformer Storage Area
	33	PCB Storage Building 659
6	9	Drummed Radioactive Waste Area
	18	Radioactive Waste Storage Building
7	5	Pole Transformer PCB Spill
8	6	Old Burn Area
	7	Chemical Range
	13	Tire Disposal Area
	22	Building 1303 Washout Pond
	23	Bomb and Shell Reconditioning Building
	36	Old Burn Staging Area
9	8	Small Arms Firing Range
	40	AED Test Range
10	41	Box Elder Wash Drum Site

[a]Solid waste management unit.

1.3.3 Previous Investigations

Numerous environmental investigations have been performed at TEAD-N in conjunction with the 57 SWMUs since 1979. A summary of the previous investigations leading up to the Phase I RI is provided as Table 1-2 of that report (*Final RI Report for OUs 4-10*, Rust E&I 1994a).

The Phase II RI field investigations conducted by Rust E&I were designed primarily to fill data gaps left from the Phase I RI and other previous investigations. Previous investigation results have been incorporated into discussions of the nature and extent of contamination, contaminant fate and transport, and risk to human health and the environment where appropriate.

1.4 REGULATORY BACKGROUND

A variety of environmental investigations have been conducted at TEAD-N from 1979 to the present. In 1987, under contract to the USEPA, the NUS Corporation published a Final Interim RCRA Facility Assessment for TEAD-N (NUS 1987), which identified 28 SWMUs.

These SWMUs were suspected or known to have released contaminants into the environment. Subsequent investigations have resulted in the identification of an additional 29 SWMUs, resulting in a current total of 57 potential hazardous waste sites at TEAD-N.

On October 2, 1984, the USEPA proposed TEAD-N for inclusion on the NPL. The facility was listed on the NPL on October 1, 1990. As a result, the USEPA, State of Utah, and TEAD entered into an FFA on September 16, 1991. In this agreement, 17 of the original 46 SWMUs were redesignated as Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites contained within 7 OUs. The remaining 29 SWMUs were covered under a Resource Conservation and Recovery Act (RCRA) Corrective Action Permit (CAP), which was issued to TEAD by the State of Utah on January 7, 1991. Under the CAP, the SWMUs were originally divided into 9 known-release SWMUs and 20 suspected-release SWMUs. Subsequent studies have resulted in the addition of eight more suspected-release SWMUs. As a result of the FFA and CAP, work plans previously prepared by E.C. Jordan Co. (E.C. Jordan 1990a and 1990b) required reformatting and revision to reflect the new division of the previously identified SWMUs. In 1991, Rust E&I prepared and submitted draft work plans for an RI/FS for the 17 CERCLA sites at TEAD-N. Phase I field investigation activities were completed in the summer of 1992.

A baseline risk assessment was performed for the 46 SWMUs identified at the time (9 known-releases SWMUs, 20 suspected-release SWMUs, and the 17 CERCLA SWMUs) (Rust 1993a). This baseline assessment was based on the preliminary data available from the site investigation phase. The RI report for the Phase I investigation at OUs 4 through 10 was prepared in 1993, and the final report was approved in February 1994 (Rust 1994a). Components of the FS were started in 1992. Memoranda were presented to summarize these steps: the determination of the remedial action objectives (*Memorandum on Remedial Action Objectives*, SEC Donohue 1992a), the screening of alternatives (*Assembled Alternative Screening Memorandum*, Rust E&I 1993b), and the detailed analysis of alternatives (*Memorandum on Detailed Analysis of Alternatives*, Rust E&I 1993c).

During the preparation of the RI and FS reports, and as part of the regulatory oversight process, discussions were held between the Army, the USEPA, and the State of Utah. As a result of these continuing discussions, it was determined that additional data needs existed for 11 of the SWMUs. To reflect the new grouping of SWMUs into those where there were data gaps and those with sufficient data, the OUs were redefined with modified boundaries. The six SWMUs in OUs 5, 6, 7, and 10 were found to have sufficient information to be carried forward to an ROD, and the final FS report was prepared for these four OUs. The FS was approved in April 1994. The Proposed Plan (PP), which provides an overall discussion of the preferred remedial alternative for a specific OU, was mailed out to the public mailing list, which is maintained by the TEAD Public Relations office in May 1994. The PP was also

announced in the local newspaper (*Tooele Transcript Bulletin*) at the same time. A public meeting was held June 2, 1994, in the Tooele County Courthouse to announce the chosen remedies for each of the six SWMUs in OUs 5, 6, 7, and 10, and to provide the public the opportunity to ask questions or enter comments into the Administrative Record. After conclusion of the public comment period, the ROD was signed by the USEPA, the State of Utah, the Army, and TEAD in September 1994.

Work plans for the Phase II data gap sampling at OUs 4, 8, and 9 were prepared, and drafts were submitted in the fall of 1993. These work plans were revised in response to comments from the USEPA and the State of Utah, and received final approval in September 1994. Field work for the Phase II was conducted in the summer of 1994.

Following the submittal of the Draft Phase II RI Addendum Report in May 1995, additional data gaps were identified for three SWMUs (6, 8, and 40). A letter work plan was prepared and submitted in October 1995 (draft and final draft) and November 1995 (final). Field work at SWMUs 6, 8, and 40 was conducted in November 1995 following receipt of regulatory comments. A Revised Draft Phase II RI Addendum Report was submitted in 1996 that included the November 1995 data.

1.5 PHYSICAL CHARACTERISTICS OF THE TEAD-N AREA

1.5.1 Physiography

TEAD-N is located in the Great Salt Lake Basin, a large interior drainage basin within the Basin and Range Physiographic Province. The Basin and Range Province is characterized by large fault blocks that trend approximately north and south, and form a series of interior basins bounded by fault-block mountain ranges.

The Tooele Valley, which is a topographic expression of a northward-plunging structural basin, is bounded by the north-trending Stansbury and Oquirrh Mountains, which rise from the valley floor at elevations ranging from 5,000 feet to over 10,000 feet. Topography of the valley floor is shaped by coalescing alluvial fans formed by erosional debris washed from the adjacent mountains. The valley floor consists of ancestral Lake Bonneville sediments. The topography at TEAD-N is characterized by a gently rolling surface intersected by a series of shallow gullies that drain the facility. The average topographic gradient in the northern portion of the site is approximately 70 feet per mile, increasing to about 150 feet per mile at the southern boundary.

1.5.2 Climate

The Tooele Valley climate ranges from arid to semi-arid. Average annual precipitation at Tooele is approximately 17 inches. At Grantsville, which is 2 miles north of TEAD-N, the average annual precipitation is approximately 11 inches. The greatest amount of precipitation occurs in the mountains surrounding the valley, where the average is more than 40 inches per

year. The normal mean annual air temperature at Tooele is approximately 51 °F although the area is characterized by hot, dry summers and cold winters. Prevailing wind direction and speed are shown in the wind rose diagram (Figure 1-3), displaying data collected at a solar-powered meteorological station installed in the northeastern portion of TEAD-N. As shown, the dominant wind direction is from the north/northwest.

1.5.3 Demographics and Land Use

With the exception of Tooele (population of 13,887), Grantsville (population of 4,500), Stockton (population of 426) (Bureau of Census 1990), residents of the on-site housing, and a scattered population living outside of these towns, the area surrounding TEAD-N is largely undeveloped. The city of Tooele contains properties immediately to the east of the TEAD-N boundary. To the north of TEAD-N, properties are used primarily for pasture and cultivation and, to the west and south, for rangeland grazing. The southeastern portion of TEAD-N is bounded by State Highway 36. On the eastern side of TEAD-N, there is a right-of-way for the Union Pacific Railroad. Tooele Municipal Airport and scattered residential homes are located east of this railroad right-of-way. The facility is bounded on the north by State Highway 112. North of Highway 112 is the Tooele County Landfill, a construction company, and undeveloped land. The city of Grantsville is located approximately 2 miles north of the northwestern corner of TEAD-N. There is some recent residential development that abuts the northeastern boundary of TEAD-N. On-base housing for both civilians and military families is located in the administrative area of TEAD-N. There are 17 military personnel with 17 dependents and 20 civilian personnel with 42 dependents currently living in on-base housing, for a total of 96 people. The average residence time is approximately 3 years (Rust E&I, personal communication with S. Culley, 1994). Also located at TEAD-N is the Tooele Alternative High School, which has 42 full-time and 100 part-time students. Additional on-site land use was previously described in Section 1.3 in terms of the types of activities conducted at TEAD-N.

The population of Tooele County has grown slightly with a total of 26,601 in 1990 compared with 26,033 in 1980 (for an approximate 2-percent increase). The city of Tooele, however, has shown a slight decrease from 14,375 in 1980 to 13,887 in 1990 (for an approximate 3-percent decrease). Much of the fluctuation in population in the Tooele Valley is related to changes in both mining and military activities. Agriculture and ranching in the area are generally stable and do not account for major fluctuations in the population. With the exception of both areas of TEAD and Kennecott Copper, industrial employers in the Tooele Valley consist of light manufacturing, industrial processing, and warehousing companies.

Water supply wells at TEAD-N (Figure 1-4) are used intermittently for industrial use and for irrigation of landscaped areas at TEAD-N. According to TEAD personnel, groundwater is sampled on an established schedule to demonstrate compliance with regulatory maximum contaminant limits (MCLs). Volatile constituents are sampled for semi-annually, while other parameters are on schedules up to every third year. Groundwater is treated at the well head with chlorine. In addition, most of the occupied buildings on TEAD-N have been retrofitted with carbon filtration or reverse osmosis units on all drinking water outlets. Primarily during

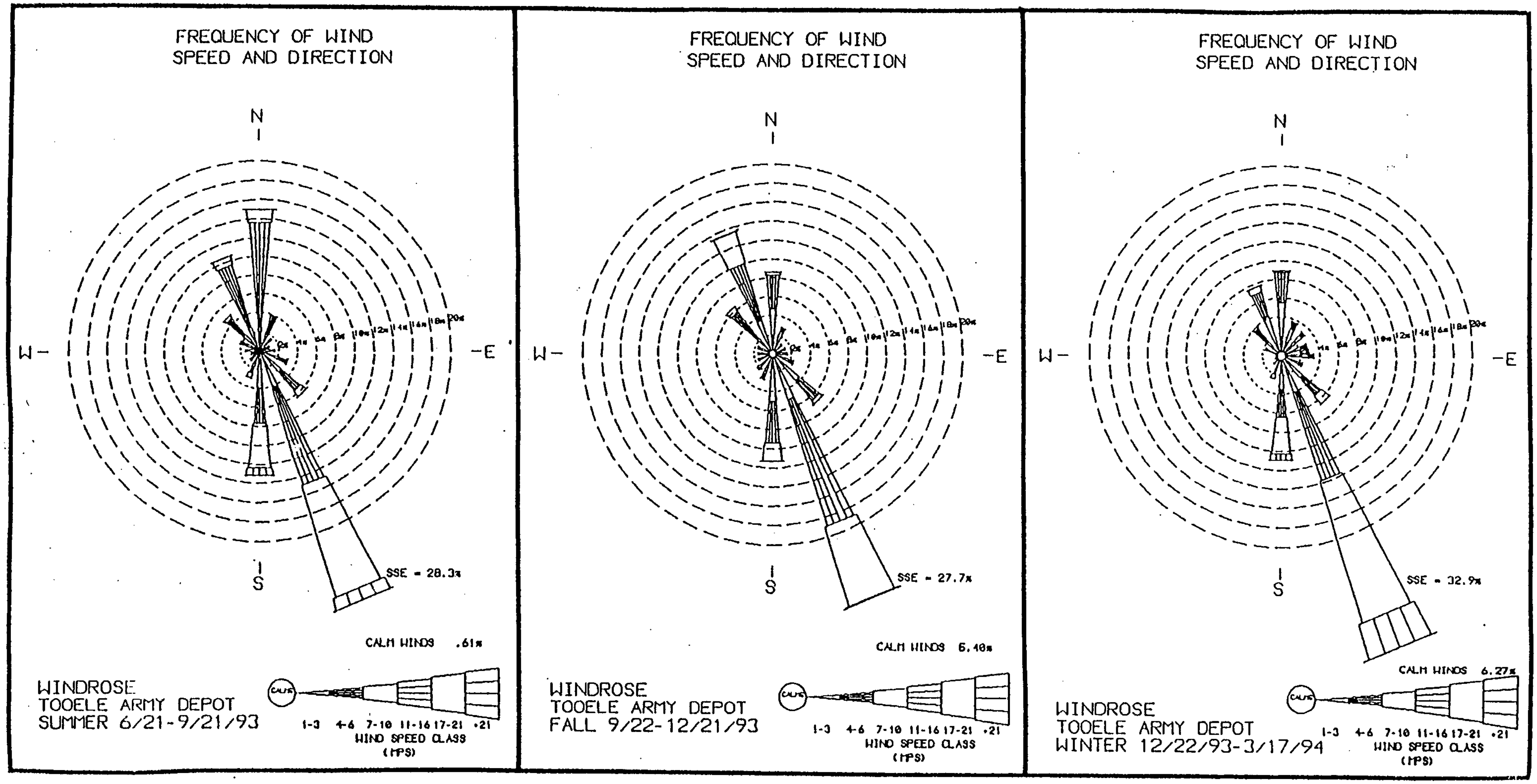


Figure 1-3. Wind Rose Diagram for TEAD-N from June 1993 to February 1994

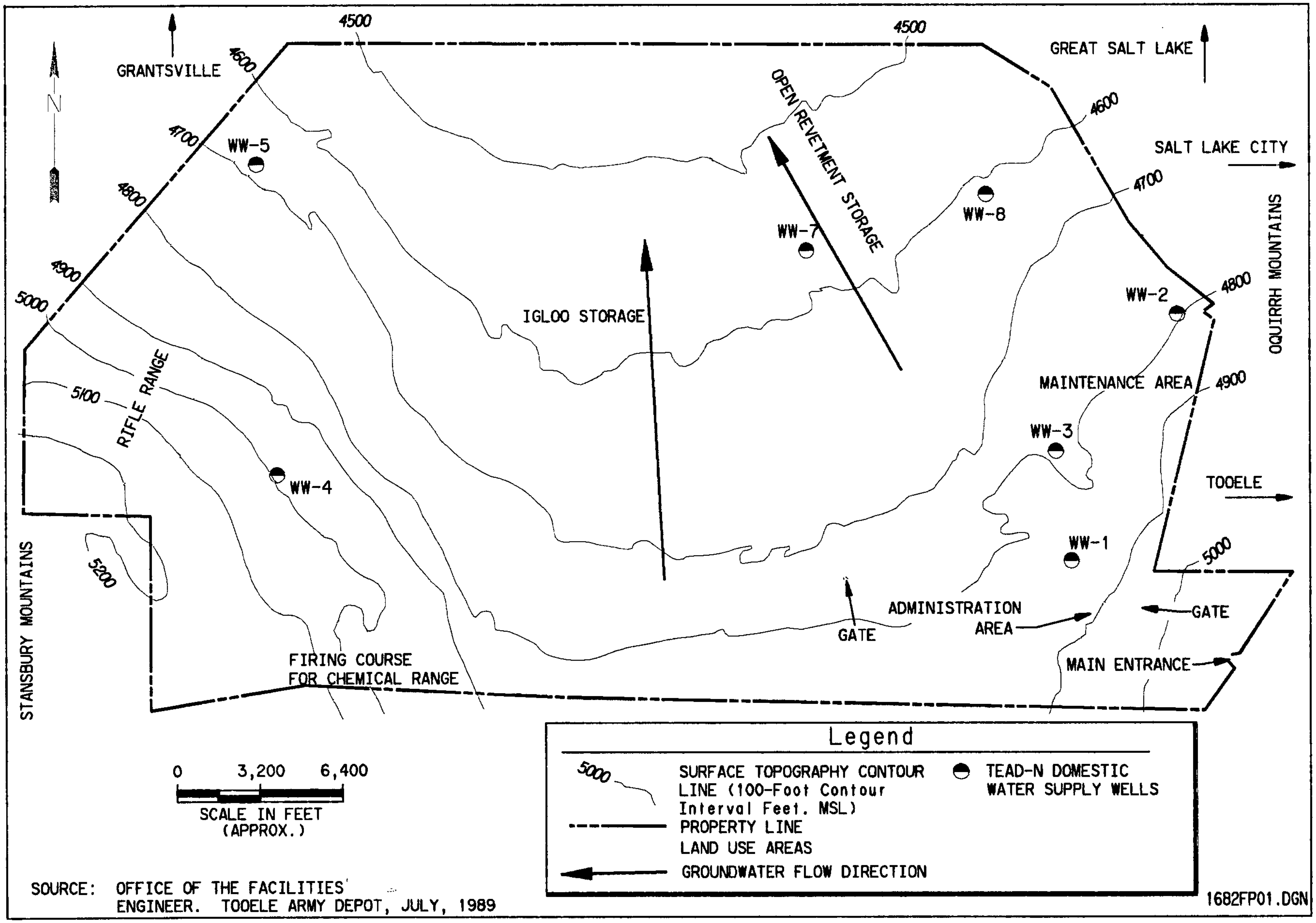


Figure 1-4. Location of Water Supply Wells at TEAD-N

the summer months, several supply wells located off site are used for irrigation and livestock watering. The town of Grantsville obtains drinking water from three community water wells (Wells 1, 2, and 3), which are located downgradient of the TEAD-N site. The city of Tooele obtains drinking water from supply wells located cross-gradient of TEAD-N, from an upgradient well, and from a surface-water source (reservoir). Previous estimates indicate that TEAD-N uses only 4 percent of the water used within the Tooele Valley. Of this water, it was estimated that 17 percent was for domestic use and the remaining 83 percent was for industrial use (Weston 1990). The industrial water is treated prior to discharge back into the hydrologic system.

1.5.4 Geology

This section briefly describes both the regional and site geological conditions. A detailed discussion of local and regional geology is contained in the Final RI Report (Rust E&I 1994a). SWMU-specific geology is discussed in more detail in Sections 4.0 through 6.0 of this report.

1.5.4.1 *Regional Geology*

Tooele Valley lies near the eastern edge of the Basin and Range Structural Province, which is characterized by fault-block mountain ranges and intervening sedimentary basins. Mountain ranges having crest lines trending north-south are located to the south, east, and west of Tooele Valley. It is bounded to the north by the Great Salt Lake. The Oquirrh Mountains and South Mountain (located to the east and south, respectively) are composed mainly of the Oquirrh Formation of Late Mississippian, Pennsylvanian, and Early Permian age. This formation consists predominantly of alternating quartzite and limestone beds. To the west, the Stansbury Mountains contain outcrops of numerous formations, the thickest of which are the Oquirrh Formation and Cambrian-aged Tintic Quartzite. The rocks of all three mountain ranges have been extensively folded and faulted (Razem and Steiger 1981).

Geologic formation of Tooele Valley is believed to have started with Laramide folding during the late Cretaceous, followed by basin and range faulting during the Miocene and Pliocene. The last major geologic force shaping the valley was the eastward tilting of the Oquirrh Mountains during the Pliocene and Pleistocene.

The valley was eventually filled with a thick sequence of unconsolidated Tertiary- and Quaternary-aged sediments deposited as alluvial fans originating from the surrounding mountains and reworked by Lake Bonneville. The Tertiary sediments comprise the Salt Lake Group, and consist of moderately consolidated sand, gravel, silt, and clay with an abundance of volcanic ash. Younger Quaternary-aged sediments consist of unconsolidated sand, gravel, silt, and clay, which includes sediments deposited before, during, and after the existence of Lake Bonneville. The surface of the alluvium has been shaped by inundations of Lake Bonneville (Razem and Steiger 1981).

Because of the varying depositional environments (lake-bottom, lakeshore, stream, and alluvial fan deposits), correlation of individual facies across the valley is not possible. Geophysical logging of the valley fill identified a sediment grain-size difference between 800 and 900 feet, at which point the sediments become much finer grained. This lithology change may mark the top of sediments of Tertiary age (ERTEC 1982). The valley fill thickness ranges from a feather edge at the valley margins to a possible thickness of over 8,000 feet in the north-central part of the valley (Razem and Steiger 1981).

Basin and range tectonism has resulted in several potentially active faults in Tooele Valley, two of which are located in the vicinity of TEAD-N. Along the base of the Oquirrh Mountains, the Oquirrh marginal fault has been observed, with evidence of post-Lake Bonneville and post-Holocene displacement interpreted from fault scarps south of Middle Canyon northward to Bates Canyon and Lake Point (Montgomery Watson (MW) 1993). In addition, post-Holocene movement was also interpreted from scarps along the Six-Mile Creek fault north of Grantsville.

1.5.4.2 *Site Geology*

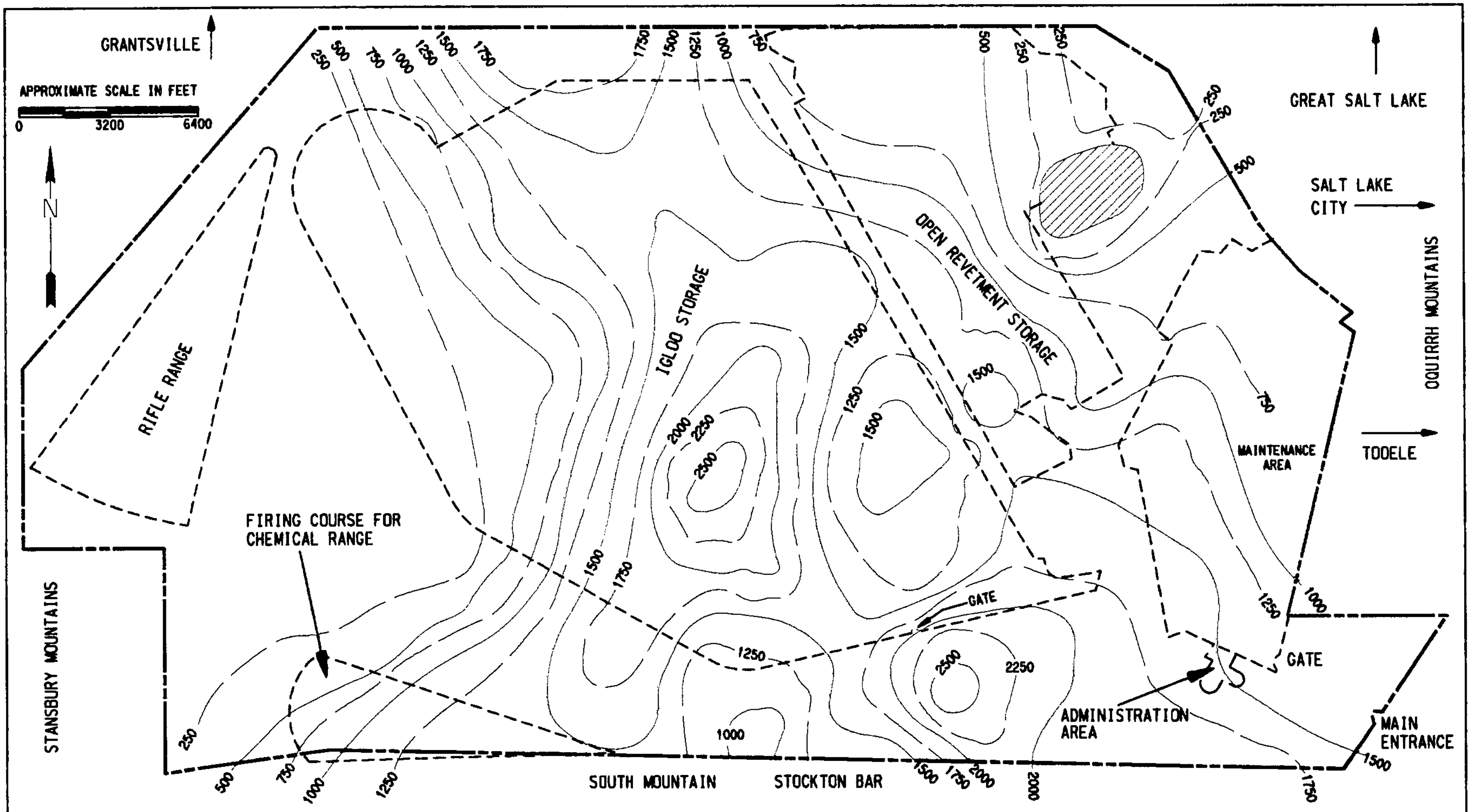
At the facility, the geologic conditions are similar to those found in other locations in Tooele Valley, with unconsolidated lacustrine and alluvial sediments overlying bedrock consisting of limestone, quartzite, and sandstone.

1.5.4.2.1 ***Valley Fill Deposits.*** The alluvial fan deposits underlying TEAD-N consist of clay to cobble-sized quartzite, sandstone, and limestone fragments. Consistent with the depositional environment, lateral changes in the grain-size of the sediment is exhibited across the site, with sediments becoming finer grained the farther from the source. As a result, along the east margin of TEAD-N, silty gravels with some cobbles and boulders are the predominant soil type, while sediments beneath the central, western, and northern portions of TEAD-N are generally silts, fine sands, and gravels (MW 1993).

The deposition of the valley fill was greatly influenced by climate, precipitation rates, and periods of inundation by Lake Bonneville. Some fine-grained layers within the valley fill range in thickness from 10 to 70 feet. These layers consist of clayey silt, silty clay, and silty fine sand, all of which may act as barriers for groundwater movement due to low permeability.

1.5.4.2.2 ***Bedrock.*** All data pertaining to the bedrock at TEAD-N are limited to previous investigations, which have focused on the bedrock block in the northeastern portion of TEAD-N and on geophysical surveys across TEAD-N. Depth to bedrock across TEAD-N ranges from surface outcrops in the northeast corner of the facility and along the southern TEAD-N boundary to greater than 2,000 feet below ground surface (bgs) in the south-central area of TEAD (Figure 1-5).

Outcrops in the northeastern portion of TEAD consist of fine-grained, blue-gray, and black limestone with calcite-filled fractures, and fine-grained-to-granular white, red, and brown



LEGEND

1000 APPROXIMATE DEPTH TO BEDROCK VALUES (FEET BELOW GROUND SURFACE)

1250 SUPPLEMENTAL CONTOUR LINES

PROPERTY LINE

LAND USE AREAS

APPROXIMATE LOCATION OF BEDROCK OUTCROPS

NOTES:

1. DEPTH TO BEDROCK CONTOURS BASED ON A GEOPHYSICAL SURVEY. (ERTEC, 1982)
2. BEDROCK BOREHOLES IN THE EASTERN PORTION OF TEAD-N GENERALLY CONFIRM GEOPHYSICAL SURVEY.

SOURCE: OFFICE OF THE FACILITIES ENGINEER, TOOELE ARMY DEPOT, JULY, 1989; ERTEC, 1982

1682HP03.DGN

Figure 1-5. Depth-to-Bedrock Contour Map

quartzite outcrops that are associated with an elongated bedrock block. This block, according to borehole and geophysical data, is oriented northeast to southwest with suballuvial flanks extending to the southwest and southeast. The outcrop to the south is similar (EA 1988).

Previous investigations measured the orientations of fractures in the northeastern bedrock outcrops. Results indicated these fractures were generally vertical or nearly vertical with strikes of about 30° to 50° west of north (JMM 1988). These directions are approximately perpendicular to the bedding planes in the outcrops, which contain extensive fracturing. Cores collected from these beds contained zones of open fractures and dissolution cavities that appeared to have developed along the fracture planes. These fractures are believed to be the primary control of the bedrock groundwater conditions (JMM 1988). Sections 1.5.5.2.2 and 1.5.5.3 describe the bedrock aquifer, hydrogeologic properties, and groundwater flow.

1.5.5 Hydrogeology

This section briefly describes the regional and local groundwater conditions for TEAD. A detailed discussion of regional and local hydrogeology is contained in the Final RI Report (Rust E&I 1994a). As previously mentioned, TEAD lies within the southern portion of Tooele Valley. Previous investigations have been reviewed and relied upon for this summary characterization of the aquifer underlying the Tooele Valley floor.

1.5.5.1 *Regional Hydrogeology*

Unconsolidated valley fill deposits and, to a lesser extent, the underlying bedrock are responsible for storing and transporting the majority of the groundwater in Tooele Valley. Hydrogeologically speaking, the bedrock aquifer is of less importance because of its low primary permeability. This aquifer consists of quartzite and limestone, and transmits groundwater only in areas that have a high degree of fracturing and solution openings.

The main groundwater source in the valley is precipitation over the surrounding mountains, where the average annual rainfall is approximately 40 inches. Groundwater recharge areas are located along the basin margins, where bedrock typically outcrops. After entering the subsurface along the valley margins, groundwater migrates downgradient toward the northwest and is discharged in the central and northern parts of the valley.

Previous estimates of average annual groundwater recharge into Tooele Valley ranged from 51,000 to 125,000 acre-feet. Computer modeling estimated an additional 5,000 acre-feet annually recharged the Tooele Valley from Rush Valley underneath the Stockton Bar, making an estimated 57,000 acre-feet of water annually (Razem and Steiger 1981). Estimates of recharge for the southeastern portion of Tooele Valley, including Stockton and Tooele, are 44,000 acre-feet per year (Stolp 1994).

Razem and Steiger (1981) further estimated the evapotranspiration to be 23,000 acre-feet per year. Transpiration has the greatest influence on the amount of precipitation available to enter the aquifer system. Taking this into account, the net annual recharge into Tooele Valley is 34,000 acre-feet.

Groundwater occurs under unconfined, confined, and artesian conditions across the valley. In the southern end of the valley, unconfined conditions exist. In the northern and central portions of the valley, both confined and unconfined groundwater conditions are present. In areas where the alluvial aquifer is overlain by low-permeable sediments (typical of the center of the valley), groundwater becomes confined. In some areas near the valley center, the artesian pressure is sufficient to produce hydraulic heads up to 40 feet above ground surface.

1.5.5.2 *Site Hydrogeology*

Directly underlying the majority of TEAD-N is an alluvial aquifer. A bedrock block, displaced as a result of basin and range faulting, outcrops over a small area in the northeastern portion of TEAD-N. Despite having different lithologic and hydraulic characteristics, the alluvial and bedrock aquifers are hydrogeologically connected and are considered a single aquifer system. However, they are described separately below because of their distinct aquifer properties.

Figure 1-6 shows the locations of groundwater monitoring and water supply wells installed at TEAD-N. Groundwater is encountered under confined and unconfined conditions. Based on previous investigations and historical groundwater level data, the shallowest depth at which groundwater is encountered is approximately 100 feet bgs along the eastern edge of the facility. In the southwest corner of TEAD-N, a boring was drilled 700 feet bgs without encountering groundwater. This represents the deepest potential depth to groundwater at TEAD-N (ERTEC 1982) (Figure 1-6).

Considering the amount of recharge to the aquifer system in Tooele Valley, only a small fraction of that volume of water directly affects TEAD-N. As mentioned earlier, the facility lies in the southern-most portion of the valley, and it has been estimated that TEAD-N is affected by no more than 35 percent of the total recharge area (JMM 1988). As a result, the recharge into the TEAD-N aquifer system is estimated to be approximately 12,000 acre-feet per year.

1.5.5.2.1 ***Alluvial Aquifer.*** The alluvial aquifer, consisting of interbedded, discontinuous, saturated alluvium and lacustrine sediments, ranges in thickness across the site from 0 (in the vicinity of the bedrock outcrop) to greater than 700 feet thick (near the southwestern TEAD-N boundary). As commonly encountered in this type of depositional environment, the alluvial aquifer consists of clay-sized particles (as a result of overback fluvial deposits and the presence of Lake Bonneville) to boulder-sized material (as part of the alluvial fan deposition). The effective porosity of the entire aquifer is estimated to be 25 percent (JMM 1988). The top of the bedrock block was not always covered by Lake Bonneville and most likely influenced the depositional environment by diverting streams to the north and south.

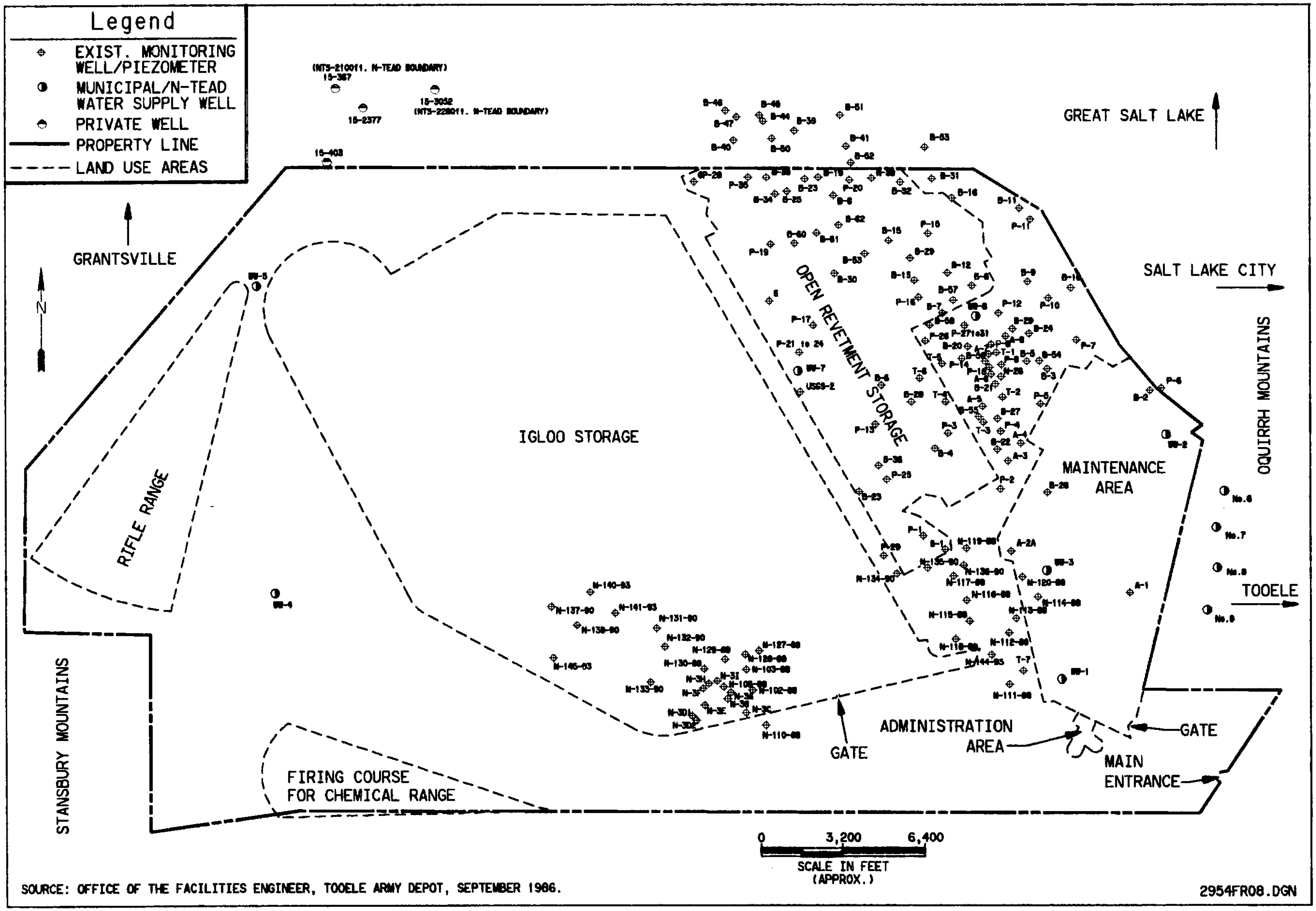


Figure 1-6. Location of Groundwater Monitoring and Water Supply Wells Installed at TEAD-N

Hydrogeologic Properties. The hydraulic characteristics of the fine-grained units of the alluvial aquifer differ drastically from the coarse-grained units. To determine the hydraulic conductivity, previous investigations have included variable head (slug) tests and short- and long-term pumping tests. During previous investigations, slug test data estimated the average horizontal hydraulic conductivity of the alluvial aquifer to be 3×10^{-2} centimeters per second (cm/sec) (MW 1993). Short term pump tests were completed on over 50 wells in the northeastern portion of TEAD-N. Results indicated the horizontal conductivity ranged from 4.7×10^{-5} cm/sec to 2.5×10^{-1} cm/sec; this wide range of values is typical of alluvial fan deposits. Slug tests conducted by Rust E&I during the Phase II RCRA Facility Investigation (RFI) for known releases SWMUs at TEAD-N indicated wells installed in the alluvial aquifer in the south-central portion of TEAD-N had hydraulic conductivities ranging from 4.6×10^{-5} to 6.1×10^{-3} cm/sec (Rust E&I 1994a).

The long-term pumping test data collected by JMM were used to determine both the horizontal and vertical hydraulic conductivity. Based on these data, the average horizontal hydraulic conductivity of the alluvial aquifer is approximately 7×10^{-2} cm/sec, while the average vertical hydraulic conductivity is approximately 1×10^{-2} cm/sec (JMM 1988).

1.5.5.2.2 ***Bedrock Aquifer***. The bedrock aquifer consists of quartzite, orthoquartzite, sandstone, and limestone. The permeability of the bedrock is very low; however, there is evidence of extensive fracturing that allows groundwater flow. The overall porosity of the bedrock aquifer material is estimated to be only 3 percent. Depths to bedrock at TEAD-N range from outcrop exposures to more than 700 feet along the western boundary. Saturated portions of the large bedrock block, which outcrops in the northern portion of TEAD-N, are considered part of the bedrock aquifer.

Core samples collected during previous investigations have indicated some zones of the bedrock are heavily fractured. During the drilling of some wells into the bedrock, there was a loss of drilling fluids into the surrounding bedrock. This is further evidence for extensive fracturing (JMM 1988).

Hydrogeologic Properties. Highly fractured bedrock yields the highest hydraulic conductivities. Unweathered bedrock and fractured bedrock with clay-filled, silicified, or calcified fractures have the lowest conductivities. Hydraulic characteristics of bedrock were estimated during previous investigations using data from pressure testing of three piezometers, short-term pumping tests, and long-term pumping tests.

According to data collected from a bedrock aquifer test completed by WCC, the horizontal hydraulic conductivity average was approximately 2×10^{-2} cm/sec (WCC 1988). Subsequent investigations by JMM included pressure testing and short-term pump tests. Pressure-testing results indicated the horizontal hydraulic conductivity was no greater than 5×10^{-3} cm/sec. During the short-term tests, the horizontal hydraulic conductivity ranged from 9×10^{-5} cm/sec for quartzite with clay-filled fractures to 9×10^{-2} cm/sec for orthoquartzite with open, interconnected fractures (JMM 1988).

1.5.5.3 *Groundwater Flow*

Regionally, groundwater originates at recharge areas along the basin margins and migrates toward the valley center. These recharge zones along the valley margins and upper reaches of the valley are characterized by downward vertical gradients. Within the valley, groundwater flows north toward the Great Salt Lake and ascends to discharge areas in the northern parts of the valley. Springs and artesian wells are typically found in these discharge areas, which are characterized by upward vertical gradients.

Groundwater contained in the alluvium at TEAD-N forms a relatively flat gradient, except in the vicinity of the bedrock block. The large difference of groundwater elevations downgradient and upgradient of the bedrock block indicates that the bedrock acts as a barrier to groundwater flow. Figure 1-7 is a groundwater contour map for TEAD-N based on groundwater elevation data collected in January 1993.

Hydraulic gradients were calculated from groundwater elevation data. Wells located in areas where the gradient changes abruptly (i.e., in the vicinity of the bedrock block) have horizontal hydraulic gradients ranging from 0.02 to 0.09. In areas with relatively flat groundwater surfaces, the gradients are much lower, ranging from 0.0005 to 0.003.

In the alluvial aquifer, the estimated groundwater velocities range from 1.2 meters per year (m/yr) to greater than 2,989 m/yr (JMM 1988), which is indicative of the heterogeneity of the sediments. Using the vertical hydraulic conductivity estimate of 1×10^{-2} cm/sec, the average calculated vertical groundwater velocity ranges from less than 0.3 to 60 m/yr (JMM 1988). For the bedrock aquifer, only the groundwater horizontal velocity could be estimated because of limited data. This value ranged from 3 to 1,677 m/yr (JMM 1988).

1.5.5.4 *Groundwater Use*

It was estimated that approximately 60 percent of the total annual discharge from the Tooele Valley groundwater system is to springs, evapotranspiration, and underflow to the Great Salt Lake. The remaining 40 percent of the discharge is to wells within the valley. Previous reports estimate the groundwater withdrawn by TEAD-N accounts for only 4 percent of the water used within Tooele Valley. At TEAD-N, the water supply wells are used intermittently, with approximately 20 percent of the withdrawn groundwater used for domestic use, and the remainder used for industrial purposes. The irrigation and livestock wells located north of TEAD-N are only in operation during the summer months (JMM 1988). In addition, the city of Tooele operates several production wells that draw water from the alluvial aquifer just east of the TEAD-N eastern boundary.

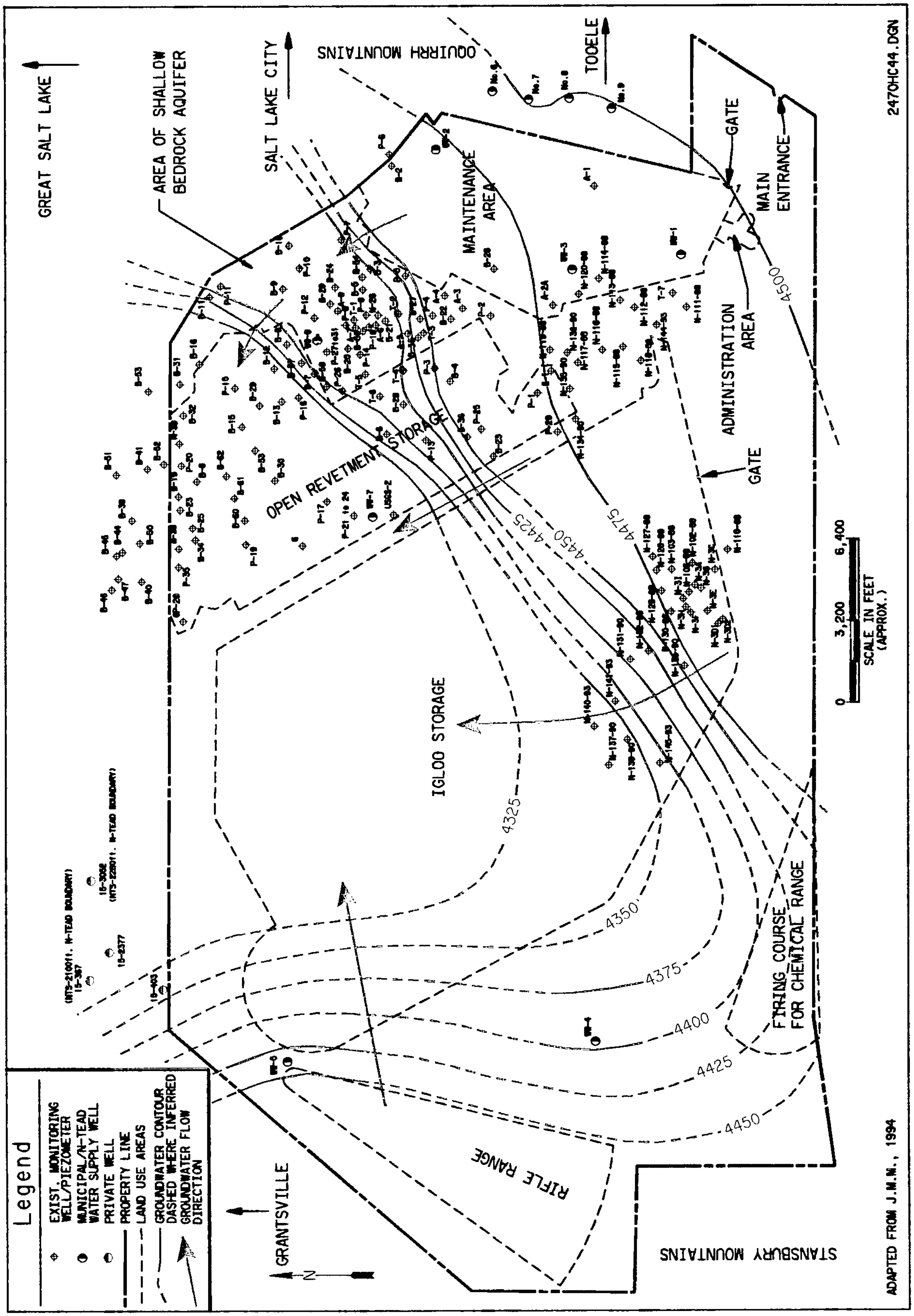


Figure 1-7. Groundwater Contour Map for TEAD-N, January 1993

1.5.6 Surface Water Hydrology

Approximately 17,000 acre-feet of water are discharged each year into Tooele Valley by ephemeral and perennial streams originating from the surrounding mountains. There are five predominant perennial streams entering the valley, four originating in the Stansbury Mountains (in Davenport, North and South Willow, and Box Elder Canyons) and one flowing out of the Oquirrh Mountains (in Settlement Canyon). Each of these streams are diverted for irrigation before or shortly after the stream exits the canyons (Razem and Steiger 1981).

There are no perennial streams at TEAD-N; however, the western boundary is intersected by ephemeral stream drainages from South Willow and Box Elder Canyons. South Willow Creek, which has an estimated annual flow of 4,830 acre-feet, is located along the northwest boundary of TEAD-N and flows to the northeast. The second ephemeral stream, Box Elder Wash, has an annual discharge of approximately 900 acre-feet and almost bisects TEAD-N, flowing to the north (Figure 1-8). Only under rare conditions (i.e., heavy rain or during the runoff of rapidly melting mountain snowpacks) does surface water carried in these drainages actually reach the facility (Razem and Steiger 1981).

1.6 SOILS

Soils in desert and semi-arid areas are categorized in three ways. The lithosols, which generally occur on slopes, ridges, and plateaus, are actively eroding "young" soils that are slightly altered examples of the parent material. The regosols, which are not found at TEAD-N, are undeveloped soils that occur in actively shifting dunes. Mature desert soils, the aridosols, make up most of the soil composition at TEAD-N. These aridosols are defined on the basis of their layers with the upper layer containing little organic matter and the lower layers consisting of clays, silts, and fine sandy materials (MacMahon 1990).

Soils that develop in semi-arid climates generally are deep, well drained, moderately permeable, and alkaline. In addition, these soils have a moderate water-erosion potential and a slight wind-erosion potential. Hydraulic conductivities of the soil in the TEAD-N area range from 1×10^{-2} to 1×10^{-4} centimeters per second (JMM 1992).

Figure 1-9 shows the different soil types found in the vicinity of the TEAD-N facility. These soils, which developed in alluvial deposits or lacustrine sediments, consist primarily of gravelly loam, loam, or fine sand. The U.S. Soil Conservation Service (SCS) has identified eight primary soil series that are found at this location: the Abela, Berent, Hiko Peak, Birdow, Medburn, Taylorsflat, Doyce, and Manessa. Additionally, two miscellaneous types were identified, Borrow Pits and Disturbed Area.

1.6.1 Environmental Setting

Parent material is the geologic source from which a soil is formed through a variety of physical and chemical processes. The type of parent material greatly influences the type of soils that develop. The soils of TEAD are derived primarily from alluvium and lacustrine deposits of mixed rock sources (SCS, unpublished 1992; Weston 1990). Climate influences soil development and productivity in several ways, such as the accumulation of organic matter in the surface layer; the translocation and chemical breakdown of soluble salts, minerals, and sediments; and the formation of distinct soil horizons. Average annual precipitation in this region ranges from about 11 to 17 inches per year, with about half occurring as winter snowfall. Flash flooding may occur in the valley primarily as a result of summer thunderstorms. Approximately 40 inches of precipitation fall in the mountains surrounding Tooele Valley.

Because of the low precipitation, soil productivity within this region is low and concretionary layers may form (SCS, unpublished 1992). This may result in decreased vegetative cover, which, in turn, reduces the amount of organic matter in the soil and its water-holding capacity. Because of the low precipitation, the translocation of salts, minerals, and clays and the resulting formation of soil horizons are limited. With a deficiency of water, dry soils do not develop strong diagnostic horizons except for salt crusts or concretionary layers. During dry periods, water can be drawn through the soil by capillary action and evaporate either in the soil profile or at the ground surface. Layers of caliche (calcium carbonate, calcium sulfate, or other evaporite salts) may accumulate in desert soils by this process. Soil crusting caused by rain impact and compaction by cattle grazing affects soil productivity by reducing infiltration rates and limiting both the depth to which salts are leached and the depth to which roots can penetrate. The sparse vegetative cover exposes more soil to raindrop impact. Raindrop impact tends to compact the soil surface and break down the soil-surface structure into a massive condition. This reduces the amount of large pore space available for infiltration. The high sodium content of many soils in the region disperses soil particles, which results in a naturally poor soil-surface structure.

The natural erosion rates of soils within the region are high due to low vegetative cover, soil crusting, low organic matter content, and easily eroded parent materials. The dispersal property of sodium causes clay and humus soil particles to become more readily detached and enables movement by wind and water. In soils, the normal situation is for clays and humus to stick to each other to form large-sized aggregations of particles resistant to wind and water. This is due to positively charged ions such as calcium and magnesium being adsorbed to negatively charged clay and humus particles, resulting in neutral particles that adhere to each other. Sodium cations are large, highly hydrated, and are only weakly adsorbed so that the number of cations adsorbed are insufficient to neutralize the positively charged particles. These particles, rather than adhering to each other, repel each other and remain or become dispersed, increasing the erodibility of the soil.

Topographic relief significantly affects soil development in terms of its drainage, elevation, aeration, aspect, steepness of slope, and susceptibility to erosion. Generally, steep south-

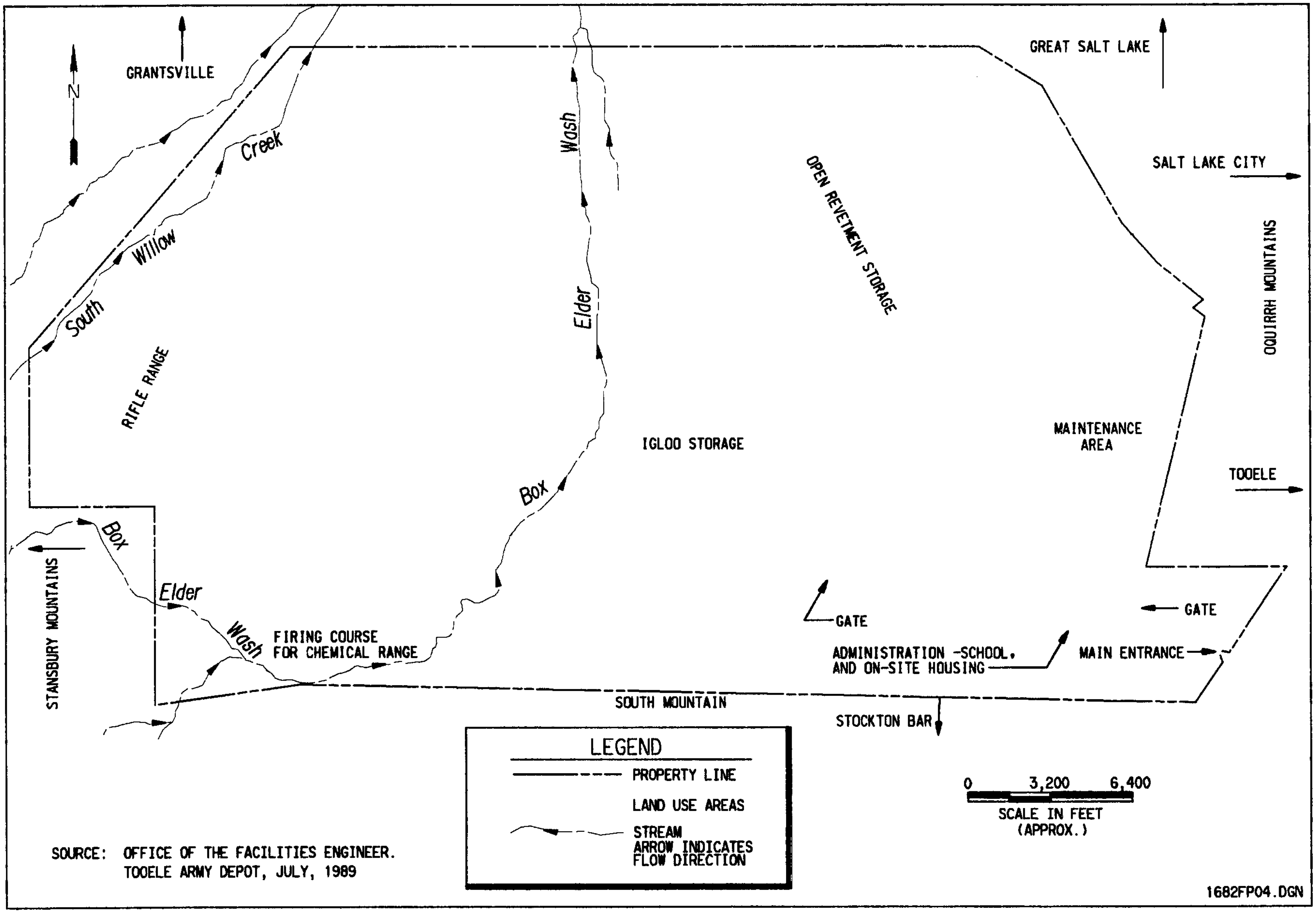


Figure 1-8. Surface Water Drainages at TEAD-N

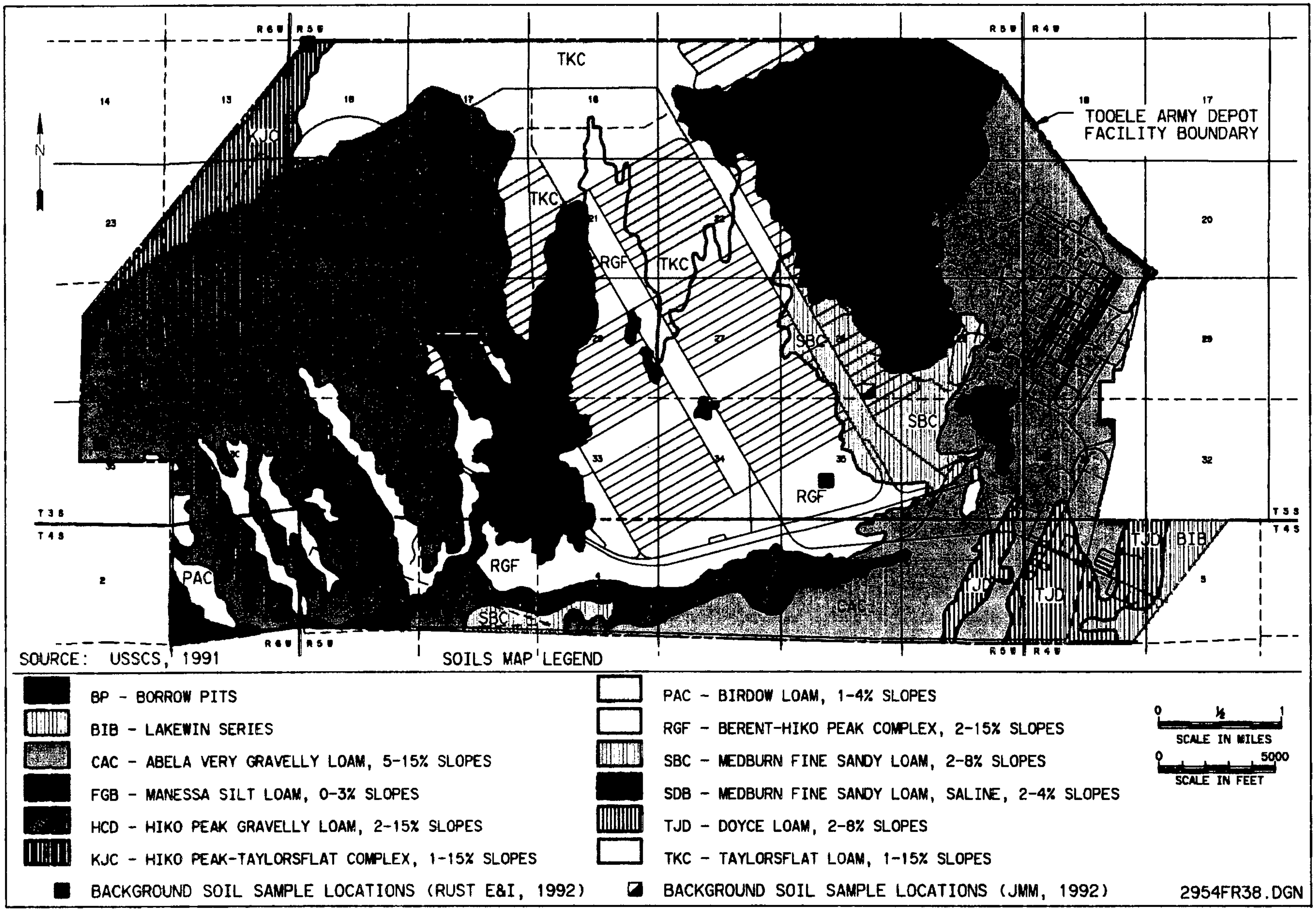


Figure 1-9. Soil Type Map for TEAD-N

facing and west-facing slopes are warmer and drier than north-facing and east-facing slopes. The result is that snow and moisture accumulate to a greater extent on the cooler, north-facing and east-facing slopes; the vegetative composition is more dense, thereby accumulating more organic matter.

1.6.2 Soil Survey Results

1.6.2.1 *Mapping Unit Descriptions*

The soil types identified on the TEAD-N facility are identified in Table 1-2, along with the approximate number of acres and percentage each occupies within the facility area. Table 1-2 also provides the general characteristics of the surface soils of the TEAD-N investigation area. These characteristics include the mapping unit, soil type, origin of the soil, general location of the soil in the landscape, the texture, depth, pH, permeability, and infiltration rate (JMM 1992).

1.6.2.2 *Soils of the TEAD-N Facility Area*

The soils of the TEAD-N site are similar in origin and character to those of the region. These soils of the TEAD-N facility area are primarily derived from alluvium and lacustrine deposits of mixed rock sources (SCS, unpublished 1992; Weston 1990). Additionally, some of the soils on the site formed in alluvium derived dominantly from limestone and quartzite. The two surficial soil types are (1) lake bed sediments with low to moderate permeability and (2) colluvium and alluvium deposits with moderate to high permeability.

The soils of the facility and adjacent areas are developing under cool and arid conditions, and are rather weakly developed overall. Because the facility area receives little precipitation (11 to 17 inches on average) and because about half of the precipitation falls during the summer months when the moisture is used by plants, very little moisture ultimately passes through the soil profile. The air temperature averages 75 °F in July and 28 °F in January; the average freeze-free period is 120 to 160 days (SCS, unpublished 1992). These relatively cool, year-round temperature conditions also limit the development of soils.

Specifically, within the northeastern portion of the TEAD-N facility area, the soils are primarily classified as Manessa silt loam and Abela very gravelly loam. The southeastern portion of the TEAD-N facility area is a mix of soils, including the Abela very gravelly loam, borrow pits (disturbed), and Doyce loam mapping units. The north-central portion of the site is largely dominated by the Taylorsflat loam mapping unit, and in the south-central area of the site, the soils are dominated by the Berent-Hiko Peak Complex. The western portion of the facility area is comprised largely of soils from the Hiko Peak gravelly loam, with fingers of Berent-Hiko Peak Complex and Hiko Peak-Taylorsflat Complex, and Birdow loam mapping units. The soils map (see Figure 1-9) shows each soil-mapping unit identified within the area.

Table 1-2. *General Characteristics of Surface Soil of TEAD-N Investigation Area*

Mapping Unit	Soil Type	Origin	General Location	SWMU # Soil Type	Characteristics: Texture	Depth (feet bgs)	Soil pH	Permeability	Infiltration Rate (cm/sec)
Abela Included in this unit are Borvant and Birdow soils.	Abela	Developed in alluvium derived primarily from limestone and quartzite.	Alluvial fans on 1 to 8 percent slopes at elevations of 4600 to 6000 feet above MSL.	31, 32	Gravelly loam (GM-GC; SC-SM)	0 to 0.8	7.9 to 8.4	Mod. rapid	$1.4x10^{-3}$ to $4.2x10^{-3}$
					Very gravelly loam (GC-GM)	0 to 1.7	7.9 to 9.0	Mod. rapid	$1.4x10^{-3}$ to $4.2x10^{-3}$
					Very gravelly loam to extremely gravelly sandy loam (GM-GC; GP-GM)	1.7 to 5	8.5 to 9.0	Mod. rapid	$1.4x10^{-3}$ to $4.2x10^{-3}$
	Borvant	Developed in alluvium derived predominantly from limestone.	Shallow soil over a carbonate cemented hardpan on fan terraces on short or medium length, convex, 2 to 15 percent slopes at elevations of 5200 to 6500 feet above MSL.		Gravelly loam (GM-GC, SC-SM)	0 to 0.5	7.4 to 9.0	Moderate	$4.2x10^{-4}$ to $1.4x10^{-3}$
					Very gravelly loam (GM-GC)	0.5 to 1.5	7.9 to 9.0	Moderate	$4.2x10^{-4}$ to $1.4x10^{-3}$
					Indurated	1.5	--------	--------	--------
Berent-Hiko Peak Complex. Included in this unit are Amtoft, Medburn, Sprager, Taylorsflat, Duneland, and Rock Outcrop soils.	Berent	Eolian sands derived from mixed rock types.	Hummocky vegetated sand dunes and fan terraces up to 30 percent slopes at elevations of 4500 to 5800 feet above MSL.	10, 11, 25	Loamy fine sand (SM)	0 to 0.5	7.4 to 8.4	Rapid	$4.2x10^{-3}$ to $1.4x10^{-2}$
					Fine sand (SM)	0.5 to 5	7.9 to 9.0	Rapid	greater than $1.4x10^{-2}$
	Hiko Peak	Developed in alluvium from mixed rock types.	Alluvial fan terraces on medium length, convex, 2 to 15 percent slopes at elevations of 4400 to 6000 feet above MSL.	6, 7, 8, 13, 22, 23, 36, 40	Gravelly loam (GM-GC)	0 to 0.5	7.9 to 8.4	Mod. rapid	$1.4x10^{-3}$ to $4.2x10^{-3}$
					Very gravelly loam (GM-GC)	0.5 to 1	7.9 to 9.0	Mod. rapid	$1.4x10^{-3}$ to $4.2x10^{-3}$
					Very gravelly loam (GM-GC)	1 to 5	8.5 to 9.0	Mod. rapid	$1.4x10^{-3}$ to $4.2x10^{-3}$
	Amtoft	Developed in alluvium derived from mixed rock types.	Rock outcrops on 30 to 70 percent slopes.		Very cobbly loam (GM-GC)	0 to 1	7.9 to 9.0	Mod. rapid	$1.4x10^{-3}$ to $4.2x10^{-3}$
					Extremely cobbly loam (GM-GC; GP-GC)	1 to 1.5	7.9 to 9.0	Mod. rapid	$1.4x10^{-3}$ to $4.2x10^{-3}$
					Unweathered bedrock	1.5	--------	--------	--------
	Spager	Developed in alluvium derived from limestone	Alluvial fan terraces on 2 to 15 percent slopes at elevations of 5200 to 6200 feet above MSL.		Gravelly loam (GM-GC; SC-SM)	0 to 0.5	7.4 to 9.0	Mod. rapid	$1.4x10^{-3}$ to $4.2x10^{-3}$
					Very gravelly loam, very gravelly fine sandy loam (GM-GC)	0.5 to 2	greater than 8.4	Mod. rapid	$1.4x10^{-3}$ to $4.2x10^{-3}$
					Indurated	2	---	---	---

Table 1-2. General Characteristics of Surface Soil of TEAD-N Investigation Area (continued)

Mapping Unit	Soil Type	Origin	General Location	SWMU # Soil Type	Characteristics: Texture	Depth (feet bgs)	Soil pH	Permeability	Infiltration Rate (cm/sec)
	Taylorsflat	Alluvium and lacustrine sediments derived from mixed rock types.	Lake terraces and alluvial fan terraces on medium length, linear to convex, 1 to 5 percent slopes at elevations of 5000 to 6000 feet above MSL.		Loam (CL-ML) Loam (CL-ML) Loam (CL-ML)	0 to 0.5 0.5 to 1.0 1.0 to 5	7.9 to 8.4 7.9 to 8.4 8.5 to 9.0	Mod. slow Mod. slow Mod. slow	$4.2x10^{-4}$ to $1.4x10^{-3}$ $1.4x10^{-4}$ to $1.4x10^{-3}$ $1.4x10^{-4}$ to $1.4x10^{-3}$
	Duneland	Sand; derived from mixed rock types.	Ridges and intervening troughs made of fine sand sized particles on lake plains and low lake terraces.		Sand (SM-SW)	NA	NA	NA	NA
	Rock outcrop	Dependent on the type of bedrock.	Exposures of barren bedrock that occur mainly on escarpments or ridges. Slopes range from 30 to 60 percent.		NA	NA	NA	NA	NA
Medburn. Included in this unit are Hiko Peak and Taylorsflat soils.	Medburn	Developed in alluvium and acustrine sediments, derived predominantly from sedimentary rocks.	Lake terraces and alluvial fan terraces on short or medium length, convex or linear, 2 to 8 percent slopes at elevations of 4500 to 5800 feet above MSL.	7	Fine sandy loam (SM; SC-SM) Fine sandy loam (SM; SC-SM) Fine sandy loam (SM; SC-SM)	0 to 0.5 0.5 to 3.5 3.5 to 5	7.9 to 8.4 7.9 to 9.0 8.5 to 9.0	Mod. rapid Mod. rapid Mod. rapid	$1.4x10^{-3}$ to $4.2x10^{-3}$ $1.4x10^{-3}$ to $4.2x10^{-3}$ $1.4x10^{-3}$ to $4.2x10^{-3}$
Birdow. Included in this unit are Erda and Lakewin soils.	Birdow	Developed in alluvium derived predominantly from limestone and quartzite.	Flood plains, stream terraces, and alluvial fans on long, linear, or slightly concave 1 to 4 percent slopes at elevations from 4250 to 6200 feet above MSL.		Loam (CL-ML) Loam (CL-ML)	0 to 2.3 2.3 to 5	7.4 to 8.4 7.9 to 9.0	Moderate Moderate	$4.2x10^{-4}$ to $1.4x10^{-3}$ $4.2x10^{-4}$ to $1.4x10^{-3}$
	Manessa	Developed in alluvium from sedimentary rocks.	Fan terraces and lake terraces, 0 to 3 percent slopes at elevation of 4250 to 4800 feet above MSL.	30	Silt loam (CL-ML) Silt loam (CL-ML, CL)	0 to 1 1 to 5	7.9 to 9.0 >8.4	Mod. slow Mod. slow	NA NA
	Doyce	Developed in mixed alluvium on fan terraces.	Fan terraces with 2 to 8 percent slopes at elevation of 4800 to 6300 feet above MSL.	35	Clay (CL) Clay (CL) Clay (CL)	0 to 1 1 to 2 2 to 5	6.6 to 7.8 7.4 to 8.4 7.9 to 9.0	Slow Slow Slow	NA NA NA
	Lakewin	Developed in alluvium and lacrustrine sediments on lake terraces.	Lake terraces on 1 to 5 percent slopes at elevations of 4700 to 5200 feet above MSL.		Silty gravelly loam (GM-GC, SC-SM, SM) Gravelly, sandy, clay loam (GM-GC, SC-SM) Gravelly sandy loam (GM) Gravelly sandy loam (GP, SP)	0 to 0.7 0.7 to 1.5 1.5 to 2.5 2.5 to 5.0	6.6 to 7.3 6.6 to 7.8 7.9 to 8.4 7.9 to 8.4	High Mod. high High Very high	NA NA NA NA

Table 1-2. General Characteristics of Surface Soil of TEAD-N Investigation Area (continued)

Mapping Unit	Soil Type	Origin	General Location	SWMU # Soil Type	Characteristics: Texture	Depth (feet bgs)	Soil pH	Permeability	Infiltration Rate (cm/sec)
	Erda	Developed in alluvium and lacustrine sediments derived from mixed rock types.	Alluvial fan terraces and lake terraces on 1 to 5 percent slopes at elevations of 4250 to 6000 feet above MSL.		Silt loam (CL-ML)	0 to 1	7.4 to 8.4	Mod. slow	1.4×10^{-4} to 4.2×10^{-4}
					Silt loam (CL-ML)	1 to 3	7.9 to 9.0	Mod. slow	1.4×10^{-4} to 4.2×10^{-4}
					Silt loam, silty clay loam (CL-ML)	3 to 5	7.9 to 9.0	Mod. slow	1.4×10^{-4} to 4.2×10^{-4}

Source: Taken from JMM, 1992.
NA=Not available.

The soils on the TEAD-N area are predominantly (approximately 47 percent) Hiko Peak and Berent-Hiko Peak soils. The Abela, Taylorsflat, and Manessa soils comprise approximately 15, 11, and 10 percent of the area, respectively. The remaining seven mapping units comprise the last 17 percent of the TEAD-N facility. The soil types present within the 11 SWMUs contained in this RIA are summarized in Table 1-2.

1.7 VEGETATION AND WILDLIFE

Plant and wildlife surveys of the TEAD-N facility have been previously conducted for the Phase I and II RI. These are in the process of being updated for inclusion in the site-wide ecological risk assessment. General discussions of the regional vegetation and wildlife, range site types, and biotic species composition are found in the following subsections.

1.7.1 Regional Vegetation

The climate of a region profoundly influences soil and vegetation development. The Tooele Valley region is classified as a cold desert, dominated by sagebrush and saltbush plant species (Figure 1-10). Soil and plant-community development are, to a great extent, a function of precipitation and temperature (Welsh et al. 1987). The amount of precipitation available during the growing season is a primary factor in determining the type of species present, number of individuals, and the general productivity of the vegetation and soils of the area. In addition to adapting to low precipitation and high evaporation rates, plants in this area have adapted to a moderately eroded soil, and some have adapted to alkaline and saline soils. The valley bottoms within the TEAD-N region are typically filled with the erosional deposits from surrounding mountain ranges and are frequently occupied in part by saline pans, salt flats, or fresh to saline lakes or ponds (Welsh et al. 1987). Distribution of plant species tends to be correlated with the geology and soils present on a site (Welsh et al. 1987). The geology of this area consists primarily of lacustrine and sedimentary material of mixed rock origins (SCS, unpublished 1992). Welsh and others (1987) noted that the plant communities that may occur on TEAD-N include Salt Desert Shrub, Riparian Communities, Cool Desert Shrub, and Juniper-Pinyon.

These four types range from moist and more productive to drier and less productive—the Upland Loam, Foothill, Sandy Hills, and Desert Bench. The Upland Loam is a sagebrush/grass vegetation type, dominated by sagebrush and other shrubs; and a variety of grasses, including wheatgrasses, bluegrass, needle-and-threadgrass, and a variety of forb species. The Foothill vegetation type is primarily a grassland vegetation type, dominated by a variety of grass species including wheatgrass, bluegrass, needle-and-threadgrass, and Indian ricegrass, as well as a number of forbs including sweet vetch, balsam root, yarrow, and snakeweed. The Sandy Hills vegetation type is an upland savannah with scattered juniper trees. Although pinyon can exist in this community, they are not present on this specific site. The following species are important: Indian ricegrass, sand dropseed, needle-and-threadgrass, sagebrush, and ephedra. Finally, the Desert Bench type, is a dry vegetation type, dominated

by shadscale, winterfat, greasewood, grey molly's alkali sacaton, spiked wheatgrass, western wheatgrass, Indian ricegrass, bud sage, and salt sage.

1.7.2 Survey Results of Range Site Types

The range site types identified on the TEAD-N facility area are identified in Table 1-3. Included are the approximate number of acres they cover and percentage of area each occupies within the facility area. Additionally, the general plant/soil relationships for the site area are also shown in this table. The Vegetation Map (Figure 1-10) shows the distribution of range site types within the facility area. The following descriptions for the range site types address general species composition and abundance based upon SCS evaluations (SCS, unpublished 1992). Plant species are identified by their common name within each range site description.

Semidesert Sand (Utah Juniper)--Semidesert Gravelly Loam (Wyoming Big Sagebrush). This range site complex occurs on the Berent-Hiko Peak, 2 to 15 percent slopes, soils complex. The Semidesert Sand range site type occurs on the Berent soil; the Semidesert Loam range site type occurs on the Hiko Peak soil. The vegetation that occurs on the Hiko Peak soil is discussed under the Semidesert Gravelly Loam range site type.

On the Berent soils, the present vegetation is Utah juniper, Wyoming big sagebrush, needle-and-threadgrass, and cheatgrass. The potential plant community on this soil is an overstory of Utah juniper with about 30 percent cover. The understory vegetation is about 45 percent perennials and also includes Indian ricegrass, fourwing saltbush, sand dropseed, scarlet globemallow, bud sagebrush, and spiny hopsage.

Semidesert Gravelly Loam (Wyoming Big Sagebrush)--Semidesert Loam (Wyoming Big Sagebrush). These range site types occur on the soils Hiko Peak-Taylorsflat Complex, 1 to 15 percent slopes. The vegetation that occurs on the Hiko Peak soil is described under the Semidesert Gravelly Loam (Wyoming big sagebrush). The vegetation that occurs on the Taylorsflat soil is described under the Semidesert Loam (Wyoming big sagebrush).

Semidesert Loam (Wyoming Big Sagebrush). This range site type occurs on two soils on the TEAD-N area: Taylorsflat loam, 1 to 5 percent slopes, and on the Medburn fine sandy loam, 2 to 8 percent slopes. The present vegetation in most areas is Wyoming big sagebrush, Indian ricegrass, and cheatgrass (SCS, unpublished 1992). The potential plant community on this range site type is about 50 percent perennial grasses, 15 percent forbs, and 35 percent shrubs. Important plant species include bluebunch wheatgrass, Wyoming big sagebrush, Indian ricegrass, bottlebrush squirreltail, needle-and-threadgrass, scarlet globemallow, penstemon, Hood phlox, and Douglas rabbitbrush (SCS, unpublished 1992).

Semidesert Alkali Loam (Black Greasewood). This range site type occurs primarily on the soil Manessa silt loam, 0 to 3 percent slopes and on the Medburn fine sandy loam saline, 2 to 4 percent slopes. The present vegetation is usually cheatgrass, crested wheatgrass, Wyoming big

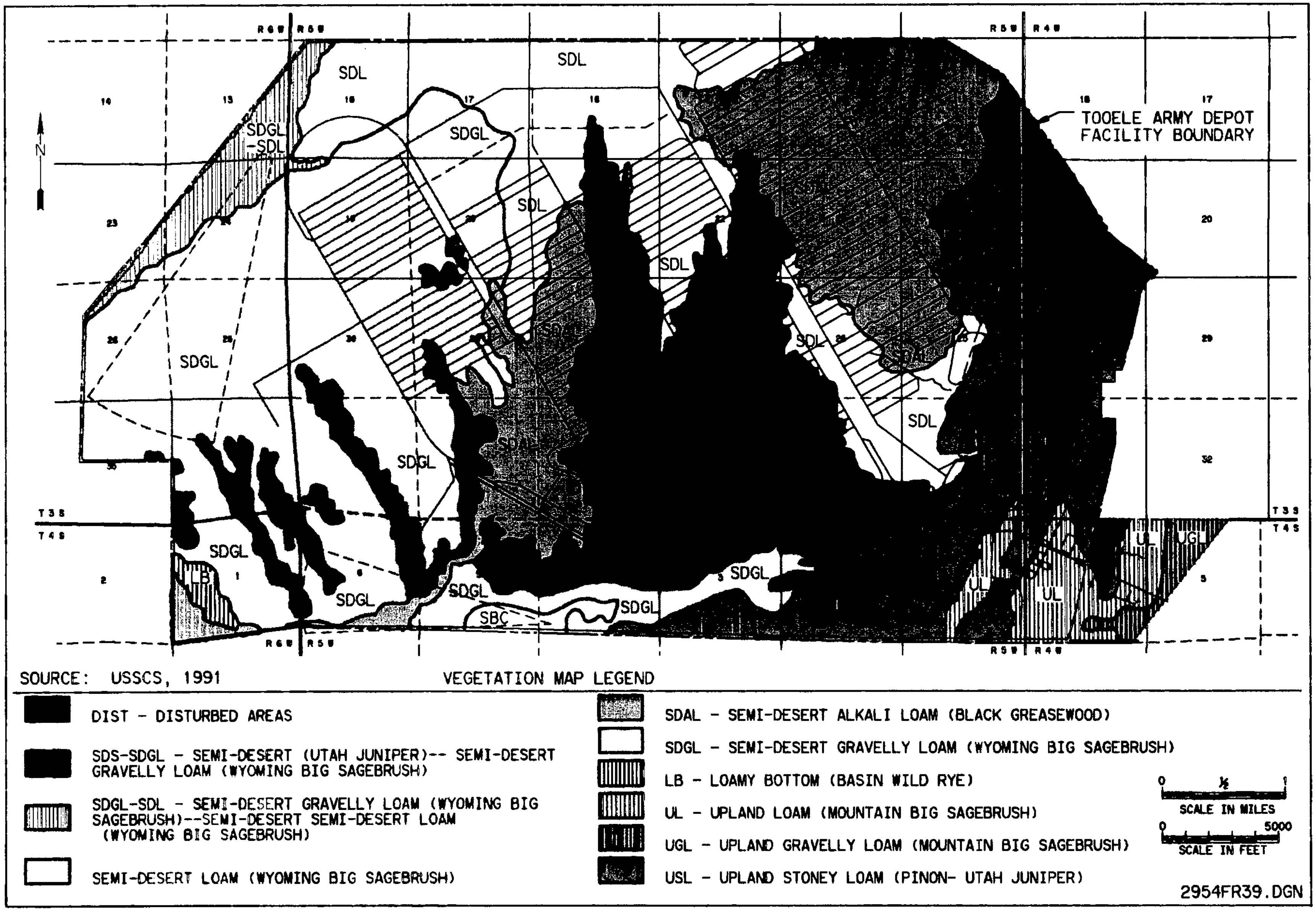


Figure 1-10. Vegetation Map for TEAD-N

Table 1-3. Range Site Types for TEAD-N

Range Site Type	Soil Type	Acres	Percentage
Semidesert Sand (Utah Juniper)--Semidesert Gravelly Loam (Wyoming Big Sagebrush)	Berent-Hiko Peak Complex	5,070	20
Semidesert Gravelly Loam (Wyoming Big Sagebrush)--Semidesert Loam (Wyoming Big Sagebrush)	Hiko Peak-Taylorsflat Complex, 1 to 15 percent slopes	480	2
Semidesert Loam (Wyoming Big Sagebrush)	Taylorsflat loam, 1 to 5 percent slopes Medburn fine sandy loam, 2 to 8 percent slopes	3,724	15
Semidesert Gravelly Loam (Wyoming Big Sagebrush)	Hiko Peak gravelly loam, 2 to 15 percent slopes	6,350	26
Semidesert Alkali Loam (Black Greasewood)	Manessa silt loam, 0 to 3 percent slopes Medburn fine sandy loam, saline, 2 to 4 percent slopes	3,942	15
Upland Stony Loam (Pinyon-Utah Juniper)	Abela very gravelly loam, 5 to 15 percent slopes	3,759	15
Loamy Bottom (Basin Wildrye)	Birdow loam, 1 to 4 percent slopes	100	1
Upland Loam (Mountain Big Sagebrush)	Doyce loam, 2 to 8 percent slopes	697	3

sagebrush, and bluebunch wheatgrass. The potential plant community on this range site is about 30 percent perennial grasses, 15 percent forbs, and 55 percent shrubs. Other important plant species include black greasewood, bottlebrush squirreltail, and Indian ricegrass.

Upland Stony Loam (Pinyon-Utah Juniper). This range site type occurs primarily on the soil Abela very gravelly loam, 5 to 15 percent slopes. The present vegetation is usually bluebunch wheatgrass, cheatgrass, mountain big sagebrush, Utah juniper, and yellowbrush. The potential plant community on this range site is an overstory of pinyon and Utah juniper with about 50 percent canopy cover. The understory vegetation is about 45 percent perennial grasses, 5 percent forbs, and 50 percent shrubs. Important plant species also include black sagebrush, bluegrass, and antelope bitterbrush.

Semidesert Loam Gravelly (Wyoming Big Sagebrush). This range site type occurs on the soil Hiko Peak gravelly loam, 2 to 15 percent slopes. The present vegetation is Wyoming big sagebrush, Douglas rabbitbrush, Indian ricegrass, and cheatgrass. The potential plant community is about 45 percent perennial grasses, 15 percent forbs, and 40 percent shrubs. Important plant species include Wyoming big sagebrush, bluebunch wheatgrass, Indian ricegrass, bottlebrush squirreltail, Nevada bluegrass, Hood phlox, rosy pussytoes, shadscale, and Douglas rabbitbrush.

Loamy Bottom (Basin Wildrye). This range site type occurs on the soil Birdow loam, 1 to 4 percent slopes. The present vegetation in most areas is basin big sagebrush, bluebunch wheatgrass, rabbitbrush, and basin wildrye (SCS, unpublished 1992). The potential plant community is about 70 percent perennial grasses, 10 percent forbs, and 20 percent shrubs. Important plant species are basin wildrye, basin big sagebrush, western wheatgrass, Nevada bluegrass, tapertip hawksbeard, and rubber rabbitbrush.

Upland Loam (Mountain Big Sagebrush). This range site type occurs on the soil Doyce loam, 2 to 8 percent slopes. The present vegetation in most areas is mountain big sagebrush, rabbitbrush, bluebunch wheatgrass, antelope bitterbrush, and some Utah juniper. The potential plant community is about 60 percent perennial grasses, 10 percent forbs, and 30 percent shrubs. Important plant species also include Indian ricegrass and bluegrass.

Disturbed. This mapping unit includes a variety of soil and vegetation types, which reflect disturbances resulting from human activities. This mapping unit includes the Borrow Pits soil mapping units (see Section 2.5), as well as other areas of the facility which have been disturbed. The soil textures in these areas vary, but they may contain toxic chemicals or metals that adversely affect plant growth. Much of this type supports less than 10 percent vegetative cover, and has no agricultural value. Some of the Borrow Pit areas, however, may have some value for wildlife habitat or industrial use. Floral composition varies, but species are generally weedy invaders, such as cheatgrass, Indian ricegrass, and rabbitbrush.

1.7.3 Flora Composition

A total of 81 species in more than 30 families have been identified within the facility area. Vegetation type and number are shown in Table 1-4.

Table 1-4. Vegetation Type and Number at TEAD-N

	Identified	**Probable**	**Total**
Trees	7	0	7
Shrubs	12	8	20
Forbs	49	50	99
Cactus	1	0	1
Grasses	12	14	26
Total	81	72	153

A current endangered species survey for flora has been conducted on the TEAD-N site and has been included in the *Draft Site-Wide Ecological Risk Assessment Report* submitted in January 1996.

1.7.4 Regional Wildlife Information

The Basin and Range Physiographic Province is a semi-arid, cold desert region characterized by low precipitation, low relative humidity, daily and seasonal temperature extremes, and moderate to high winds. The summers are typified by hot, dry, sunny days and cool nights; the winters are generally cold and snowy. The average annual precipitation is about 17 inches. The normal mean annual air temperature is approximately 51 °F, with monthly average temperatures ranging from a high of 75 °F in July to a low of 28 °F in January. There are an average of 120 to 160 frost-free days.

The extant plant species and vegetation communities as well as the climate in the Tooele Valley have affected the available forage and accessible animal niches. The animals in this region have adapted to these environmental factors by specializing as hibernators, estivators, and diurnal or nocturnal species. The region is inhabited by a wide variety of animal species, ranging from mammals to protozoans. These species may occur as permanent residents, temporary or seasonal residents, or on a migratory basis.

1.7.5 Wildlife Species at TEAD-N

Approximately 127 species have been identified in the near vicinity of the TEAD-N facility area. Of these, 58 species were mammals and 63 were birds (Table 1-5). Additionally, 6 reptiles were also identified. No fish or amphibians were identified. Wildlife species noted were observed by Rust E&I personnel during the field investigation. Other listed species were compiled from references (Burt 1980, Peterson 1990, Stebbins 1985).

Table 1-5. Wildlife Type and Number at TEAD-N

		Identified	Probable	Total
Mammals				
	Small	56	18	74
	Large	2	3	5
Birds		55	70	125
Raptors		8	7	15
Reptiles		6	10	16
Total		127	108	235

A current endangered species survey for wildlife has been conducted on the TEAD-N sites and has been included in the *Draft Site-Wide Ecological Risk Assessment Report* (Rust E&I 1996).

2.0 PHASE II INVESTIGATION METHODOLOGY

The work conducted during the Phase II investigation followed methods and procedures previously established in the approved RI/FS work plans for Phase I and supplemented for Phase II. These work plans include the *Final Work Plan; Final Field Sampling Plan; Final Quality Assurance Project Plan* (CNES 1992a, b, and c); *Final Work Plan for Phase II Remedial Investigation and Site-Wide Ecological Assessment, Volume I: Addendum Work Plan and Quality Assurance Project Plan* (Rust E&I 1994b); and the *Final Letter Work Plan for Additional Fieldwork for SWMUs 6, 8, and 40.* This section provides a summary of procedures used, including a description of any deviations from the previously approved field-operating procedures, and changes to the analytical laboratory program.

An assessment of data quality has been made for both laboratory and field data. The methodology to determine background levels of inorganics (metals and cyanide) is explained in this section. Also, an evaluation of the potential for site contaminants to migrate through the vadose zone is provided. Sampling of groundwater was not possible for 10 of the 11 SWMUs in the Phase II RI as wells are not available in the west and northwest portions of the facility. This evaluation is provided to support the conclusion that installation of monitoring wells is not necessary.

2.1 SAMPLING METHODOLOGY

2.1.1 General Sampling Approach

Table 2-1 presents a summary of the field investigation and laboratory analysis program for the Phase II RI. This table presents the data gaps identified, the objectives of the proposed investigations, and general approach used to fill the data gaps and meet the project objectives.

2.1.1.1 *Sample Selection*

To determine the type, number, location, depth, and analytical parameters of samples to be collected during the Phase II RI, Rust E&I conducted a thorough review of all previous investigation results as well as findings from the Phase I RI. This review resulted in the identification of data needs as presented in Table 2-1. The sample locations selected for the Phase II investigation were primarily designed to further define the vertical and horizontal extent of the potential contamination. Detailed discussions on specific sampling and analysis conducted for each SWMU are presented in the SWMU-specific sections (Sections 4.0 through 6.0).

For areas where the contaminant releases were shown to be related to ditches, pits, and trenches, sample locations were generally biased toward those specific release sites with primary emphasis on defining vertical extent. For other SWMUs, such as the Former Transformer Boxing Area (SWMU 31) or the Tire Disposal Area (SWMU 13), no previous

Table 2-1. Summary of SWMU-Specific Data Needs

Site	SWMU	Previous Findings	Identified Data Gaps	Additional Data Required
OU 4				
Former Transformer Boxing Area	31	No previous sampling had been conducted at this SWMU, and the extent of contamination, if any, is unknown. However, it is suspected that contamination could have occurred since this location was used as a temporary storage area for transformers. No leaks or spills were reported.	No previous sampling had been conducted.	Surface soil samples were collected across the site to determine if spills or releases had occurred. Analytical suite: analyze for PCBs in all samples, with one-third of these samples also analyzed for metals, SVOCs, and VOCs.
PCB Spill Area	32	Composite soil samples detected low levels of residual PCBs remaining in the soil after cleanup from two punctured electrical transformers.	Previous sampling did not define the vertical and horizontal extent of the residual PCBs.	To verify the PCB cleanup was complete, subsurface soil samples were collected from borings located in the vicinity of the spill. In addition, surface soil samples were collected to determine if additional spills or releases have occurred. Analytical suite: each sample analyzed for PCBs, with one-third of the samples also analyzed for metals, SVOCs, and VOCs.
Wastewater Spreading Area	35	Phase I activities included the collection of soil samples from the ditches, ravines, and spreading area. These samples contained detectable concentrations of the pesticides alpha and gamma chlordane. Metals were detected in concentrations above background.	Previous sampling did not define the vertical and horizontal extent of the pesticides and lead. In addition, it had not been determined if the nearby water supply well, WW-1, has been impacted.	Surface and subsurface soil samples were needed from the ditches, ravines, and spreading area for laboratory analysis. In addition, a groundwater sample was needed from water supply well WW-1 to determine if groundwater has been impacted. All soil samples analyzed for pesticides; four samples in wastewater spreading area also analyzed for metals. Groundwater analyzed for pesticides, metals, explosives, SVOCs, and VOCs.

Table 2-1. Summary of SWMU-Specific Data Needs (continued)

Site	SWMU	Previous Findings	Identified Data Gaps	Additional Data Required
OU 8				
Old Burn Area	6	Prior to Phase I, soil samples were collected at depth from borings located adjacent to former trenches. Laboratory analytical results showed the samples did not contain detectable concentrations of explosives or inorganics. During Phase I, a geophysical survey identified additional target areas where test pits were located for soil sampling. Soil samples collected from these test pits contained elevated concentrations of metals and explosives, and buried debris was encountered in two of the test pits. Soil samples collected from shallow drainage areas north of the SWMU contained detectable concentrations of metals and explosives.	The horizontal extent of surface contamination was not defined, as well as the horizontal and vertical extent of contamination in the former trenches. Additional geophysical anomalies require investigation. Burning activities at the SWMU may have resulted in dioxin/furan contamination.	Soil samples from test pits were necessary to fully characterize contaminants in this area, and surface soil samples to determine if contaminants have migrated off site through surface runoff. Analytical suite: metals, explosives, and dioxins/furans.
Chemical Range	7	Prior to Phase I, surface soil samples were collected from the two open trenches at the firing point. According to the analytical results of these samples, several metals were present above background concentrations. During Phase I, a geophysical survey identified three target areas where surface and subsurface soil samples were collected. Results indicated only anions in concentrations above background.	The former open trenches were not adequately located during Phase I. In addition, the open trench at the Northwest Test Area and the firing course have not been investigated.	Surface soil and subsurface soil samples from test pits were necessary to more fully characterize contamination at this SWMU. Three areas to be sampled: firing point, northwest test area trench, and firing course. Analytical suite: metals, explosives, and SVOCs.
Tire Disposal Area	13	No previous sampling has been conducted at this SWMU, and the extent of contamination, if any, is unknown.	No previous sampling had been conducted.	Surface soil and subsurface soil samples from borings at locations across the site were necessary to determine if past activity has resulted in the introduction of contaminants at this SWMU. Analytical suite: metals, VOCs, and SVOCs.

Table 2-1. Summary of SWMU-Specific Data Needs (continued)

Site	SWMU	Previous Findings	Identified Data Gaps	Additional Data Required
Bldg. 1303 Washout Pond	22	As part of Phase I activities, surface soil samples were collected in areas which received washdown water. Results indicated detectable concentrations of metals, explosives, and at one location, cyanide.	Phase I sampling did not define the horizontal and vertical extent of contamination caused by wastewater discharge.	Surface soil and subsurface soil samples from borings were necessary to determine the vertical and horizontal extent of contamination around the ponding area. Analytical suite: metals, explosives, and cyanide.
Bomb and Shell Reconditioning Building	23	During Phase I, soil samples were collected from ditches which received washdown water from the building, the discharge areas for the ditches, and areas of surface staining. Metals, cyanide, SVOCs, and PCBs were found.	The extent of contamination resulting from the wastewater discharge needs better definition. Sampling was needed to define the horizontal extent of contamination along the perimeter of the paved area.	Surface soil and subsurface soil samples from borings were proposed. Analytical suite: metals, cyanide, SVOCs, PCBs in drainage areas.
Old Burn Staging Area	36	During Phase I, a geophysical survey did not identify any target areas for subsurface sampling. Of the surface soil samples collected, analytical results indicated metals were present in detectable concentrations. Explosives, SVOCs, and anions were not present in detectable concentrations.	Phase I sampling did not define the vertical or horizontal extent of the metals contamination.	Surface soil and subsurface soil samples from borings were necessary to determine the vertical and horizontal extent of metals. Analytical suite: metals.
OU 9				
Small Arms Firing Range	8	Composite soil samples were collected during Phase I. Lead was present in concentrations above background. TCLP results indicate there were leachable concentrations of barium, cadmium, lead, and mercury, with only lead exceeding regulatory limits for TCLP.	Based on the results of the Phase I sampling, the vertical and horizontal extent of metals contamination was not defined. Three areas defined as requiring investigation: firing points, bullet stop berms, and overshot area behind berms.	Surface soil and subsurface soil samples from shallow borings were necessary to determine the vertical and horizontal extent of the various metals. Analytical suite: metals.

Table 2-1. Summary of SWMU-Specific Data Needs (continued)

Site	SWMU	Previous Findings	Identified Data Gaps	Additional Data Required
AED Test Range	40	Phase I activities included geophysical surveying, surface soil sampling adjacent to the building foundation and in revetments, and surface and subsurface sampling from test pits. Analytical results from collected soil samples indicated detectable concentrations of explosives and metals.	Horizontal and vertical extent of explosives and metals distribution was not defined based on the limited Phase I sampling. Scattered debris including fragments of propellant and UXO required further investigation to evaluate associated risk to human health and the environment.	Surface and subsurface soil samples were needed from test pits at numerous locations across the site in order to further characterize the site. Analytical suite: metals and explosives. A grid survey across the entire SWMU was conducted to characterize the types and distribution of surface debris. Soil samples were collected beneath propellant and analyzed for anions and select explosive compounds.
OUs 4, 8, 9				

Homegrown Vegetables	6, 23, 40	NA	Information needed for the human health risk assessment on transfer of contaminants through food produced on OUs.	Grow radishes, chard, and green beans in soils collected at SWMUs 6, 23, and 40, plus a reference location.
				Analytical suite:
				SWMU 6–metals, explosives
				SWMU 23–metals, SVOCs, PCBs
				SWMU 40–metals, explosives
				Reference location–metals, explosives, SVOCs, PCBs

data existed since the SWMUs were not sampled during the Phase I RI. For these sites, a systematic approach was used over a broad area to characterize horizontal and vertical extent of potential contamination. Grids were established over the entire SWMU, and samples were collected at selected or random grid point locations.

Other sample locations were biased toward contaminant release areas identified through Phase II geophysical surveys or visual observation (i.e., soil staining). The sampling locations in these areas were not designed to fully define the extent of contamination but were selected to determine what contaminants, if any, were present.

For SWMUs that had been previously investigated, a more systematic approach was used to fill data gaps. For these SWMUs, Phase II sample locations were selected in specific areas where the vertical and horizontal extent of contamination required better definition. These data also facilitated the evaluation of contaminant fate and transport and potential risk to human health and the environment.

2.1.1.2 *Parameter Selection*

Analytical parameters selected for each sample were initially determined on the basis of historical information gathered that provides evidence of the waste materials generated or stored at each SWMU, visual evidence of spills or releases (i.e., ground staining, surface debris, geophysical anomalies), previous analytical results obtained from each SWMU, and regulatory requirements for contaminant identification and characterization.

Parameters selected for the Phase II RI were normally part of standardized suites of analytical parameters to allow easy comparison of collected data with regulatory standards and guidance. These suites include the Target Compound List (TCL) for volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs), and the Target Analyte List (TAL) for metals. Other parameters, such as polychlorinated biphenyls (PCBs), dioxins/furans, explosives, and cyanide, were selected on the basis of specific knowledge of their presence in past operations or previous investigations at TEAD-N. A specific suite of analytes (i.e., nitrocellulose, nitroguanidine, nitroglycerine, ethyl centralite, phthalates, and anions) was selected for SWMU 40, where propellant fragments are present in surface soils. This suite was based on propellant composition information received from the TEAD Ammunition Equipment Directorate (AED).

2.2 GENERAL FIELD INVESTIGATION PROCEDURES

2.2.1 Surface Soil Sampling

Surface soil sampling was performed at all 11 SWMUs during the Phase II RI field investigation. The following section describes the basic procedure used to collect surface soil samples at these locations. This procedure covers both surface (0 to 6 inches in depth) and near-surface (greater than 6 inches and less than 5 feet in depth) soil sampling.

Prior to sampling, the immediate sampling area was cleared of debris and litter. Stainless-steel spoons or hand-operated stainless-steel barrel augers were used to penetrate surface and near-surface soil to the desired depth to obtain the samples. Depth for surface samples was generally 0 to 6 inches. The sampling equipment consisted of either large stainless-steel spoons or a stainless-steel auger bit attached to a stainless-steel rod and a "T" handle. The auger bit was used to bore a hole to the desired depth and was then withdrawn. The barrel portion of the auger bit holds the soil cuttings and eliminates contact with the sidewall of the boring, which minimizes the potential of contaminating the soil from other parts of the hole. The auger was used mainly where soil samples were to be collected at intervals deeper than 6 inches and up to 3 feet in areas that were inaccessible to a drill rig. Typically, samples from the hand auger were collected at depths of 3 feet.

For VOC samples, stainless-steel spoons were used to transfer sample material directly to the sample bottle. For the remaining samples, the spoons were used to transfer samples into a stainless-steel mixing pan where the material was homogenized prior to being bottled. For samples collected by auger barrel, a stainless-steel spoon and/or knife was used to remove the sample from the auger barrel. The material was then placed in a stainless-steel tray for thorough mixing prior to bottling. Sample material to be analyzed for VOCs was bottled immediately "as-is" upon removal from the auger barrel to avoid excess loss of volatiles (generally within 45 seconds). The sample material removed was also immediately scanned with a photoionization detector (PID) and visually inspected to aid in decisions concerning sample packaging, handling, shipping, and personal-protection requirements. No elevated PID measurements were encountered during the Phase II RFI at surface soil locations. Following sample collection, the sampling equipment was decontaminated according to USAEC-specified procedures, as discussed in Section 2.2.10.

2.2.2 Soil Boring, Drilling, and Sampling

Subsurface soil sampling was conducted through the use of split-barrel sampling with hollow-stem augers. A truck-mounted hollow-stem auger rig was employed to complete subsurface soil sampling where lithologic conditions permitted (the method could not be used in cobble-to boulder-sized gravels at some SWMUs). The rig was equipped with a hydraulically driven hammer used to advance the split-barrel sampler to desired sampling intervals. All equipment was decontaminated using a steam cleaner prior to the start of each boring. Where required, a utility survey was performed prior to the start of drilling.

A plastic ground cover was placed over the ground surface at the borehole location in order to catch soil cuttings and prevent contamination of the surface soils. With the auger rig centered over the predetermined boring location, a 3-inch outside diameter (OD) by 24-inch-long stainless-steel split-barrel sampler was driven from the surface to the full length of the sampler (2 feet) and a sample was collected. Hollow-stem augers were then used to auger to the top of the next sample interval. A center bit was used within the augers to keep soils from entering the inside of the auger. At the top of the next sample interval, the center bit was removed and the split-barrel sampler was lowered through the augers to the top of the interval to be

sampled. From there, it was driven 2 feet. This procedure was repeated for each sampling interval.

Once the sample barrel was driven and filled with sample material, the sampler was removed from the borehole and placed on a clean flat surface, and the drive head and shoe were removed to expose the sample. The sample was then immediately scanned with a PID to determine the presence of VOCs in the sample. A geologist then described the resulting core sample, noting changes in lithology, color, staining, odor, or any other characteristic that might affect the resulting analytical data.

Following collection of a sample for VOC analysis (where required) and lithologic logging, the sample material was removed from the split-barrel sampler using stainless-steel spoons and placed in a stainless-steel mixing pan where the sample was homogenized. Bottles were then filled using the same stainless-steel spoons and were properly labelled, packaged, and stored in an ice-filled cooler prior to laboratory shipment.

At the completion of sample collection, the augers were pulled and the cuttings were returned to the boring. Additional native soils were used to fill the remainder of the boring when necessary. All drilling and sampling equipment was then decontaminated prior to reuse.

For each boring, a borehole log was maintained. Borehole logs are presented in Appendix A, where they are arranged by SWMU.

2.2.3 Test Pit Excavation and Sampling

As discussed in the work plan, excavation of test pits was planned to collect subsurface data at three SWMUs: the Old Burn Area (SWMU 6), the Chemical Range (SWMU 7), and the AED Test Range (SWMU 40). In addition, the high gravel content of the soils at four other SWMUs made it impossible to complete the subsurface soil sampling from soil borings. The four SWMUs that required test pit excavations rather than soil borings for soil sampling are the Wastewater Spreading Area (SWMU 35), the Tire Disposal Area (SWMU 13), the Bomb and Shell Reconditioning Building (SWMU 23), and the Old Burn Staging Area (SWMU 36).

Each of the test pit excavations followed the basic steps described below:

1. Utility clearing of the test pit site was completed prior to the start of any work at the site. Final clearance was achieved once the unexploded ordnance (UXO) personnel completed a scan of the location using magnetic locators to determine if buried metal objects were present.

2. A plastic ground cover was placed adjacent to the test pit area to ensure the excavated material did not come into contact with surface soils.

3. The test pit was excavated in several depth increments after the surface area was cleared. Excavation proceeded slowly, with the excavation checked for UXO every foot of depth. In addition, the UXO contractor performed a visual inspection of the test pit for evidence of UXO.

4. After each increment was dug, the sampler visually inspected the pit to determine the appropriate intervals for sampling. The site geologist or field sampling technician guided the backhoe operator to the specific depth or material to be sampled.

5. The backhoe operator closely monitored the excavation while digging and stopped excavation when (1) any metal debris or other potential waste material were encountered or (2) distinct changes of materials were encountered.

6. The backhoe operator then removed the material from the hole and lowered the bucket several feet away from the pit. Once the bucket was lowered, UXO personnel visually inspected the material to be sampled. Once the material was cleared by the UXO personnel for sampling, the sampling team scanned the material with a PID and collected the sample.

7. The test pit was sampled with soil from several locations near the center portion of the backhoe bucket. To avoid contamination of the sample from the bucket, the top layer of soil was scraped away from the center of the bucket. No personnel were allowed in the test pit for sampling activities.

8. The depth of the test pits varied according to the site conditions but generally were excavated to a depth of at least 10 feet. Sampling depths were also variable but were generally at depths of 0, 2, 4, 8, and 10 feet.

9. Following sampling, the test pit was backfilled with stockpiled material and natural local soil (as required). The surface was graded and restored to its original condition following the test pit excavation.

10. Test pit locations were marked by constructing permanent concrete test pit monuments. As the pit was backfilled, a 3-foot length of 6-inch-diameter cardboard tube was placed so that there was a 1-foot stickup above the fill surface. A length of rebar was placed inside the tube, and the tube was filled with concrete. Markers were placed in the top of the post to indicate test pit number and date of installation.

Soil collected was placed in a stainless-steel mixing pan and homogenized (using a stainless-steel cutter and spoon) prior to bottling. The sample material was placed in the bottles using a stainless-steel spoon. For samples to be analyzed for VOCs, however, the sample was immediately placed in the appropriate container "as-is" and sealed to avoid excess volatile loss (generally within 45 seconds).

Test pits were logged by the site geologist as they were being excavated (see Appendix B). This logging included (1) a sketch of the pit location, (2) a profile sketch showing materials encountered, (3) the depth of the materials, and (4) the location of all samples collected from the pit. The test pit logs also contained any pertinent measurement data (e.g., PID readings) or observations that could affect the quality or evaluation of the resulting data. In addition, photographs were taken of buried debris or other unusual features that were encountered. These photos are included in Appendix C.

2.2.4 Geotechnical Testing of Soils

Approximately 15 percent of the soil samples collected for laboratory analysis were also submitted to Applied Geotechnical Engineering Consultants, Inc. of Salt Lake City, Utah, for geotechnical soils testing. Samples were selected to provide broad coverage of the geographic area and to represent the range and frequency of soil types encountered. The geotechnical soils tests and methods include the following:

- Particle Size Distribution—American Society for Testing and Materials (ASTM) C 136
- Atterberg Limits—ASTM D 4318
- Hydrometer Analysis—ASTM D 422
- Unified Soil Classification—ASTM D 2487

The results provided confirmation of field determination of soil types and characteristics, and also provided information for contaminant fate and transport modeling. Results of geotechnical testing of soils are provided in Appendix D.

2.2.5 Groundwater Sampling from Water Supply Well

A groundwater sample was collected from production well WW-1, located near the Wastewater Spreading Area (SWMU 35). This sample was analyzed for metals, explosives, pesticides, VOCs, and SVOCs. The supply well consisted of a 20-inch-diameter well, 763 feet deep, with a pump set at 418 feet used to supply domestic water for TEAD. The well contains a permanent 100-horsepower turbine pump with associated piping leading to a chlorination unit. Prior to sampling, approximately 26,000 gallons were pumped from the well through the system. Using a valve located in the piping ahead of the chlorination unit, Rust E&I periodically placed water in a stainless-steel bucket for measurement of pH, conductivity, and temperature while the well was being purged. With flow from the discharge value restricted to a trickle, Rust E&I sampled the well following USAEC sampling procedures.

The sample collected for VOC analysis was pre-acidified, filled to just overflowing, and capped with no headspace. The vials were checked for bubbles by inverting the vial and tapping lightly. For the metals sample requiring filtration, the unfiltered sample was collected first and a 0.45-micron cellulose-acetate filter was then inserted in-line from the discharge valve in order to collect the filtered sample.

2.2.6 Sample Identification

Each sample collected during the Phase II RFI was assigned a unique identification number that was easily identifiable as to the site (e.g., OB = Old Burn Area), sample media type (e.g., P = test pit, B = soil boring), year collected, and location. An example of a subsurface soil sample number for the Old Burn Area is OBP-94-01B. Actual samples collected for each SWMU are presented in Sections 4.0 through 6.0 of this report.

2.2.7 Sample Handling, Storage, and Shipping

All containers were cleaned to meet USEPA standards and were quality control analyzed by the supplier. Each carton of containers contained a certificate of the QC analysis. Containers were visually inspected for integrity and cleanliness prior to use. Suspect containers were not used and were discarded.

Sample bottles for liquid inorganic analyses were filled to approximately 90 percent of capacity to allow for expansion of the contents. Sample bottles for liquid organic analyses other than VOCs were filled with minimum headspace. The 40-milliliter vials used for VOC analysis were filled with no headspace or bubbles.

Sample preservation was performed immediately upon collection. For acidified samples, the pH was checked prior to shipment to ensure proper preservation except for VOC samples, which were pre-acidified. Ice chests were used to cool the samples for shipment. Temperature blanks were placed in each cooler to allow the laboratory to perform a direct temperature reading on the cooler contents upon opening the cooler. Since a local laboratory was used, the samples were delivered by Rust E&I personnel at the end of each day.

2.2.8 Field Surveys and Measurements

2.2.8.1 *Land Surveying*

Test pit locations in SWMUs 6, 7, and 40; revetment locations; and one building were established by traditional surveying methods utilizing AAA Engineering and Drafting, Inc. of Salt Lake City, Utah. Monitoring wells N-137-93 and N-140-93, located in the X-ray Lagoon (SWMU 3) area, were used for survey control points. Coordinates were established in the State Plane system. The land survey results are presented in Appendix E.

For other sample locations, a tape-and-compass technique was used. From a previously established location, a measuring tape and compass were used to establish map coordinates for individual sample locations.

2.2.8.2 *Geophysical Survey*

Although the basic geophysical survey procedure established for the Phase I RI was utilized for the Phase II RI, several improvements to the system were made between Phases I and II. The new system still employs a Geonics EM-31 Ground Terrain Conductivity System (magnetometer) but utilizes a Data Acquisition Navigation System (DANS), which is tied to a Global Positioning System (GPS) for constant monitoring of geophysical survey location. The previous system used relied on a series of sonic receivers and an ultrasonic transmitter for obtaining location information.

The actual survey was completed according to the previously established procedure which called for the establishment of a survey grid followed by an operator walking along each grid line to transmit conductivity readings, in real time, to a receiver and computer located in a field van. Real-time processing of the data during the survey allowed immediate printouts and graphical presentation of the data. The results of the geophysical survey at SWMU 7 are presented in Appendix F.

In addition, the Geonics EM-31 was used at SWMU 6 to verify the location of the anomalies that were mapped during the Phase I field investigation in 1992. Using the maps, the instrument was carried to the approximate location of each anomaly. Small traverses were conducted in the area until the anomaly was located. A stake was placed at the center of the anomaly, and test pits were excavated at the staked locations.

2.2.8.3 *Walking Survey for Identification of UXO, Debris, and Propellant*

At the AED Test Range (SWMU 40), a walking survey of the entire area was conducted in November 1995 to further evaluate potential risks to human health and the environment and to evaluate potential remedial action alternatives related to the presence of UXO, debris, and propellant on the ground surface. Rust E&I and subcontracted EOD personnel (EOD Technologies, Inc.) conducted a survey of the SWMU 40 area by establishing a 200-by-200-foot grid and walking each grid line to record all UXO, propellant, and other debris encountered. The location of each item was recorded on a grid map. Photographs were taken of all UXO items and areas of propellant with photograph locations indicated on the appropriate grid map. Pin flags were used to mark UXO and propellant locations to allow TEAD to remove or destroy in place the identified materials following the Phase II RI survey. Results of this survey are included in Appendix Q.

At four of the grids where an abundant amount of propellant was found to be present, a detailed survey (coverage of entire grid area) was conducted to further define the types and distribution of propellant and to identify ten locations for sampling of soils to evaluate the potential for leaching of contaminants from each type of propellant. Chemical compositions of each type of propellant were obtained from TEAD prior to the start of field investigation activities, and specific analytes were identified for laboratory analysis. These included explosives, cyanide, anions (nitrate/nitrite, sulfate, and perchlorate), selected SVOCs

(phthalate esters, diphenylamine, and ethyl centralite), and other chemicals specific to propellant (i.e. nitrocellulose, nitroglycerine/PETN, and nitroguanidine). Both surface and shallow subsurface (2 feet) soil samples were obtained.

2.2.9 Control, Sampling, and Disposal of Wastes

Field sampling procedures used during the Phase II RI were designed to control and minimize the amount of wastes requiring off-site disposal.

2.2.9.1 *Personal Protective Equipment*

All visible waste was removed from personal protective equipment prior to placing in plastic bags for disposal into a facility garbage bin. This removal occurred within the contaminant reduction zone using proper decontamination techniques to control the spread of possible contaminants.

2.2.9.2 *Drill Cuttings*

Unsaturated drill cuttings were returned to the boring from which they originated, and the boring location was leveled to its original condition. Saturated conditions were not encountered during the field investigation. Therefore, it was not necessary to contain any drill cuttings in 55-gallon drums.

2.2.9.3 *Decontamination Wastes*

Decontamination liquids were transported to the Industrial Waste Treatment Plant (IWTP) for disposal and treatment. The remaining residual soils were placed in a 55-gallon drum. During the full extent of Phase II equipment/personnel decontamination, less than a quarter of one 55-gallon drum of residual soils was generated. A sample from the residual soil was collected and analyzed for RCRA hazardous waste characteristics, Toxicity Characteristic Leaching Procedure (TCLP) parameters (metals and organics), and SWMU-specific COPCs on the basis of previous waste operations and environmental investigation results. This drum was transported to the 90-day yard and properly disposed of by TEAD personnel.

2.2.10 Decontamination Procedures

Adequate decontamination of excavation and sampling equipment is critical to prevent cross-contamination. The backhoe and drill rig were cleaned using a hot-water high-pressure cleaning unit. Other sampling equipment, such as spoons and pans, were washed and rinsed following USAEC-approved decontamination procedures. To verify the effectiveness of

decontamination, equipment rinse blanks were collected from the stainless-steel sample-collection equipment (i.e., spoons and pans). Rinse blanks were collected at a rate of 1 per day or 1 per 20 samples per equipment type.

Prior to the start of the 1994 field-sampling activities, water from supply well WW-3 was sampled by another TEAD-N contractor (SAIC) to ensure that water used for the purpose of decontamination was free from contaminants. The sample was analyzed for the TAL inorganics, TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, anions, petroleum hydrocarbons, and explosives. The sample data were submitted to and approved by USAEC prior to the start of sampling activities. References to "USAEC-approved water" relate to water sources found to not contain elevated concentrations of the above-specified analytes. The water-supply well WW-3 was used to obtain water for the purpose of decontamination.

The drill rig, associated drilling equipment, and backhoe were decontaminated at the constructed decontamination pad, located south of the ammo area and west of the rifle range. Decontamination involved the removal of all visible soils and other potentially contaminated materials using a hot-water high-pressure washer. Decontamination of the drilling equipment and backhoe was performed upon arrival at the TEAD-N facility, prior to starting work at each SWMU, and upon completion of all drilling at TEAD-N. In addition, the drilling equipment was decontaminated between borings for all SWMUs.

Because of the remote location of some SWMUs (40, 22, 23), a portable decontamination station was constructed for decontamination of the backhoe. This station consisted of a round, 4-foot-diameter metal tub with overspray protection attached to the sides. The portable decontamination station was located in the contamination reduction zone at each remote SWMU and was maintained on a 10-by-20-foot sheet of 10-mil plastic to further control overspray. Decontaminated wastewater was pumped from the metal tub at the end of each day and disposed of at the IWTP.

Small sampling equipment and supplies (e.g., hand auger barrels, spoons, knives, and pans) were decontaminated on site using decontamination pans with USAEC-approved water for washing and distilled water for a final rinse. Loose material was removed prior to washing using a brush. Following the clean-water wash and distilled-water rinse, the equipment was allowed to air dry before use. The equipment was wrapped in aluminum foil after it was dry. All decontamination wastes were containerized and properly disposed of.

Upon completion of the Phase II sampling effort, all decontamination tubs, brushes, portable metal tubs, and sheet plastic were cleaned with a high-pressure hot-water rinse at the decontamination pad south of the ammo area. After all decontamination activities were completed, the decontamination pad was washed with a high-pressure hot-water wash and dismantled. Prior to dismantling, all decontamination wastewater was removed and subsequently disposed of at the IWTP. Residual soils were added to the 55-gallon drum. Materials (i.e., plastic sheeting, fence posts, fencing, plywood) were stacked for disposal at an approved location at the direction of TEAD-N personnel. The area and location of the constructed decontamination pad was cleaned of any trash, graded with the backhoe, and returned to its previous condition.

Monitoring equipment that could not be immersed in water was cleaned using damp disposable paper wipes, and dried using dry disposable paper wipes. The internal workings of the equipment were cleaned in accordance with procedures recommended by the manufacturer. Protective coverings were used to protect the instrument's outer surface from contamination.

Sample containers were wiped off with clean disposable wipes and then placed in Ziploc™-type plastic bags to prevent contamination of the sample shipping container and other samples during shipment.

2.2.11 Homegrown Vegetable Garden

As a part of the Phase II RI field investigation, the cultivation and analysis of homegrown vegetables were planned. This experiment was designed to provide data to be used in the future on-site resident scenario for the human health risk assessment.

Soils were collected from locations of known contamination within SWMUs 6, 23 and 40, and a reference background location located just west of the Ammo Area, but not down gradient of SWMU 40. Vegetable varieties were selected to represent vegetables commonly grown in home gardens in the local area; in addition, they represented vegetables consumed for the leaf, root, and fruiting-body (fleshy) parts. The varieties planted were chard, radishes, and green beans.

It was proposed that the edible portions of the vegetables would be harvested and submitted for chemical analysis. Measurement of COPC concentrations in the vegetable tissue was proposed to evaluate the potential health effects (both carcinogenic and chronic noncarcinogenic) of consuming vegetables raised on soils within the TEAD-N SWMUs.

Unfortunately, the growth trials were unsuccessful. The first planting was consumed by insects as soon as the seeds sprouted, and the first trial was aborted. A second garden trial was performed by placing the soils in containers within a constructed framework that included a fine-mesh screen cover for protection from insects and shade-cloth on the south- and west-facing sides for protection from the intense summer sun. A drip irrigation system was installed, and the containers were inspected frequently to ensure that the soil was kept adequately moist. To approximate actual growing conditions at each SWMU and to avoid the potential addition of COPCs, the seeds were planted in the soils without the addition of organic matter (i.e., peat moss) or fertilizers. This resulted in some compaction and crusting of the soils.

Very few seeds sprouted, and of those that did sprout, most did not thrive. It was determined that the controlled growth trials for vegetables would not yield sufficient plant material (only minor amounts of radish leaves were produced) for analysis. The second trial was terminated in September, and the soils were returned to the respective SWMUs and the reference location where the material was originally collected.

Prior to returning the soils, a sample from each container (representing SWMUs 6, 23, and 40, and the reference location) was submitted to the Soil Testing Laboratory at Utah State University at Logan for analysis. The analysis consisted of tests to determine current levels of nitrogen, phosphorus, potassium, salinity, pH, and lime. The Soil Testing Laboratory then provided a report on the current conditions of the soils and fertilizer or other treatment requirements to allow crops or gardens to be grown. The report indicated that the soils were very high in salt (at "toxic" level). Leaching of these salts would be necessary before crops could be grown. The results of the evaluation of the soils by the Soil Testing Laboratory are presented in Appendix G.

Thus, it can be assumed that, in the event there is future residential development at any of the SWMUs within OUs 4, 8 and 9, a garden of homegrown vegetables could not be grown directly in the soils as they are presently found. The soil would require either treatment or supplemental materials added. This would alter the overall chemistry of the native soils and possibly dilute or destroy any COPCs presently associated with the soils at these SWMUs. Residual COPCs could still be of concern; however, there is no way of quantifying the extent of this possibility with the available data.

2.3 SUMMARY OF DEVIATIONS FROM THE WORK PLANS FOR PHASE II ACTIVITIES

Deviations from the *Addendum Work Plan* and *Letter Work Plan for Additional Fieldwork* for TEAD-N were primarily the result of subsurface lithology and mostly related to substituting test pits for soil borings. Table 2-2 lists the sample locations and corresponding depths where a deviation occurred, along with a description of the cause for deviation.

Similarly, the analytical laboratory ensured that the integrity of the samples was maintained from receipt to analysis. The following procedures were used once the sample arrived at DataChem Laboratories, Inc.:

- A sample receipt officer assessed the integrity of the sample upon opening each sample shipment in terms of physical damage or any condition that could affect the laboratory analysis. Subsequently, all samples were logged onto a cooler inventory form with the field sample number, date and time of arrival, condition of the sample on arrival, and analyses required.

- The person receiving the shipment also maintained chain-of-custody (CoC) by signing the CoC form upon opening the shipping container. At that time, the laboratory logged in each sample and established an internal CoC through sample analysis and data reporting. A copy of each CoC form is maintained with the completed data package for each set of analyses.

- When not undergoing preparation or analysis, each sample was stored in a sample security area, maintained at 4 °C, which was only accessible to the sample custodian.

Table 2-2. Summary of Deviations from the Work Plan for Phase II RI Field Activities

Sample Number	Original Depth	Result	Comments
<u>SWMU 6</u>			
OBP-94-01E	10 ft	Not Taken	Sampling was stopped at 7 feet because of loose, unconsolidated material sluffing off. Sample quality would be compromised if collected at deeper depths due to potential mixing.
OBP-94-01F	12 ft	Not Taken	
OBP-94-02F	12 ft	Sample taken at 3 ft not at 12 ft	Sampling stopped at 12 feet because of loose, unconsolidated material sluffing off. Sample quality would be compromised if collected at deeper depths. A burn area at 3 feet was found in the pit. Sampling crew decided to take sample of burned area in place of sample at 12 feet.
OBP-94-03E OBP-94-04E	10 ft	Not Taken	Sampling was stopped at 7 feet because of loose, unconsolidated material sluffing off. Sample quality would be compromised if collected at deeper depths, due to potential mixing.
OBP-94-03F OBP-94-04F	12 ft	Not Taken	
OBP-94-05A	0 ft	Not Taken	While digging an observation pit, the sampling crew came across a burn pit. A decision was made to sample the burn pit at 5, 7, and 10 feet. Samples were not collected at 0, 2, and 12 feet in this particular pit.
OBP-94-05B	2 ft	Not Taken	
OBP-94-05F	12 ft	Not Taken	
OBP-94-06F OBP-94-07F OBP-94-08F OBP-94-10F	12 ft	Not Taken	Sampling was stopped at 10 feet because of loose, unconsolidated material sluffing off. Sample quality would be compromised if collected at deeper depths, due to potential mixing.
OBP-95-01A	0 ft	Resample	Broken bottle during shipment. Had to move several feet to undisturbed location for replacement sample.

Table 2-2. Summary of Deviations from the Work Plan for Phase II RI Field Activities (continued)

Sample Number	Original Depth	Result	Comments
OBP-94-12A	0 ft	Test pit added	A test pit was added because sampling of an observation pit was done. This pit was numbered 12 since number 11 was used to designate the duplicate. This pit was only sampled to 10 feet because of loose, unconsolidated material sluffing off. Sample quality would be compromised if collected at deeper depths, due to potential mixing.
OBP-94-12B	2 ft		
OBP-94-12C	5 ft		
OBP-94-12D	7 ft		
OBP-94-12E	10 ft		
OBS-94-13	0 ft	Resample	Laboratory reported zinc concentration as greater than (GT) 10,000. Location was resampled to determine actual levels of zinc.
<u>SWMU 7</u>			
CRS-94-04 through CRS-94-15	0 ft	Locations moved	Sampling locations proposed in the work plan included an area west of SWMU 7, which has been determined to be in SWMUs 16 and 10. Sample locations for the Firing Course Area relocated to provide coverage of this smaller area.
CRP-94-13A, B, and C through CRP-94-15A, B, and C	0, 5, 10 ft	Locations moved	Sampling locations proposed in the work plan included an area west of SWMU 7, which has been determined to be in SWMUs 16 and 10. Sample locations for the Firing Course Area relocated to provide coverage of this smaller area.
<u>SWMU 8</u>			
SAB-95-01B	3 ft	2.3	Coarse gravel prevented hand augering to the proposed depth. Depth of sample was maximum depth achieved.
SAB-95-02B	3 ft	2.1	
SAB-95-05B	3 ft	1.5	
SAB-95-06B	3 ft	1.5	
SAB-95-07B	3 ft	2.3	
SAB-95-11B	3 ft	2.4	
<u>SWMU 13</u>			
TDB-94-01A through TDB-94-15A	0 ft	Renamed TDP-94-01A through TDP-94-15A	Renamed because of different technique used to sample. Sampling crew decided sampling would be easier with a backhoe instead of boring with a drill rig, due to coarse cobble to boulder gravel in the soil.
TDB-94-01B through TDB-94-15B	5 ft	Renamed TDP-94-01B through TDP-94-15B	

Table 2-2. Summary of Deviations from the Work Plan for Phase II RI Field Activities (continued)

Sample Number	Original Depth	Result	Comments
SWMU 23			
BRB-94-01A BRB-94-03A BRB-94-06A BRB-94-07A BRB-94-08A BRB-94-09A BRB-94-13A	0 ft	Renamed BRP-94-01A BRP-94-03A BRP-94-06A BRP-94-07A BRP-94-08A BRP-94-09A BRP-94-13A	Renamed because of different technique used to sample. Sampling with a backhoe instead of a drill rig was conducted because the sample material encountered was coarse cobble to boulder gravel.
BRB-94-01B BRB-94-03B BRB-94-06B BRB-94-07B BRB-94-08B BRB-94-09B BRB-94-13B	3 ft	Renamed BRP-94-01B BRP-94-03B BRP-94-06B BRP-94-07B BRP-94-08B BRP-94-09B BRP-94-13B	Renamed because of different technique used to sample. Sampling with a backhoe instead of boring with a drill rig was conducted because the sample material encountered was coarse cobble to boulder gravel.
BRB-94-01C BRB-94-03C BRB-94-06C BRB-94-07C BRB-94-08C BRB-94-09C BRB-94-13C	5 ft	Renamed BRP-94-01C BRP-94-03C BRP-94-06C BRP-94-07C BRP-94-08C BRP-94-09C BRP-94-13C	Renamed because of different technique used to sample. Sampling with a backhoe instead of boring with a drill rig was conducted because the sample material encountered was coarse cobble to boulder gravel.
SWMU 32			
PPB-94-02C	12 ft	Sample collected at 10 ft bgs rather than 12 ft bgs	Drilling rig refusal at 10 feet bgs; as a result, collected deepest sample at that depth.
PPB-94-08C	12 ft	Sample collected from 13 ft bgs rather than 12 ft bgs	At 12 feet bgs, had low sample recovery. Sampler driven to 13 feet bgs to obtain an adequate volume of soil for laboratory analysis.
SWMU 35			
WSB-94-01	3 ft	Sample collected at 1.5 ft not 3 ft	Soil too hard and rocky to collect sample deeper than 1.5 feet bgs.
WSB-94-02 WSB-94-03 WSB-94-04 WSB-94-07 WSB-94-08	3 ft	Renamed WSP-94-02 WSP-94-03 WSP-94-04 WSP-94-07 WSP-94-08	Renamed because of different technique used to sample. Soil too hard and rocky to take sample with a hand auger. Sampling was conducted with a backhoe.

Table 2-2. Summary of Deviations from the Work Plan for Phase II RI Field Activities (continued)

Sample Number	Original Depth	Result	Comments
WSB-94-05	3 ft	Sample collected at 2 ft not 3 ft	Soil too hard and rocky to collect sample deeper than 2 feet bgs.
<u>SWMU 36</u>			
OSB-94-01A through OSB-94-06A	0 ft	Renamed OSP-94-01A through OSP-94-06A	Renamed because of different technique used to sample. Sampling with a backhoe instead of boring with a drill rig was conducted, due to a coarse cobble to boulder gravel encountered.
OSB-94-01B through OSB-94-06B	3 ft	Renamed OSP-94-01B through OSP-94-06B	
OSB-94-01C through OSB-94-06C	5 ft	Renamed OSP-94-01C through OSP-94-06C	
Homegrown Vegetable Garden			Sufficient volume of vegetables could not be harvested for sampling and analysis.
<u>Field QC Samples</u>			
3ER-17		Sample not collected	Numbers in the sequence were inadvertently skipped.
3TB-06		Sample not collected.	

2.4 LABORATORY CHEMICAL ANALYSIS PROGRAM

All samples collected for this Phase II RI were analyzed using USAEC performance-demonstrated analytical methodologies as described in the *Addendum Work Plan* and *Quality Assurance Project Plan*. USAEC performance-demonstrated methods were used for all analyses except for dioxins/furans that were analyzed by EPA Method 8290.

2.4.1 Sample Handling Procedures

Field packaging, labeling, and storage were designed to ensure that the integrity of the samples was not compromised during handling in the field and shipment from the field to the laboratory. Sample handling and sample custody procedures followed are described in the *Quality Assurance Project Plan* (Rust E&I 1994b).

2.4.2 Analytical Methods

Soil and water samples collected during Phase II were analyzed by DataChem Laboratories, Inc., located in Salt Lake City, Utah. Table 2-3 presents a listing of the analytical methods used and their corresponding certified reporting limits (CRLs). Analytical methods used for all analytes except dioxins/furans during the Phase II RI were performance-demonstrated methods in accordance with USAEC QA/QC criteria, which are equivalent to the USEPA analytical procedures. DataChem is also a State of Utah certified laboratory. All samples were processed through the entire analytical method exactly as specified by USAEC or USEPA except as noted with flag or qualifier codes in the database. Sample results are provided in Appendix H. This appendix is arranged by SWMU and organized into groups by test method (i.e., explosives, metals, SVOCs, VOCs, pesticides, and PCBs). A guide to the Installation Restoration Data Management System (IRDMIS) flag codes and data qualifiers is located in Appendix I. Table 2-4 provides a comparison of USAEC and USEPA data qualifiers.

2.4.3 Data Reporting

All numerical results were reported in terms of concentration in the environmental sample. The concentrations were expressed as micrograms per gram (μg/g) for soil/sediment and micrograms per liter (μg/L) for surface water and groundwater. These results were entered into the USAEC IRDMIS following approval of the data by USAEC Chemistry Branch personnel. Any correction factors were entered separately into IRDMIS. All data were collected during periods when calibration and control systems were in place and in use. Only concentrations measured within the performance-demonstrated range for each analyte were reported. The validity of the data was ensured by entering data in bound, pre-numbered notebooks or standardized bench sheets. The notebook pages were signed, dated, and reviewed by an independent party. The resulting analytical laboratory reports were completed with the following information:

- Project identification, report recipient, sample-receipt date, report date, and sample type
- Appropriate references, noting any modifications made to the referenced method
- Analytical results for each field sample
- Quality control results, including method blank and spike-recovery results
- Statistics, indicating range and precision of the method
- Calibration curve data used for the analysis
- Additional pertinent information such as interferences from other analytes

These data reports were signed by the analyst and by reviewers responsible for producing the data. Nonconformance reports and the resolution of the problem are included with the report, if applicable.

Table 2-3. Summary of Analytical Methods

Parameter	Code	Method Type[a]	Soil CRL[b] (µg/g)[c]	Soil Method Number	Water CRL (µg/L)[d]	Water Method Number
Metals and Cyanide						
Silver	AG	ICP	0.80	JS12	10.0	SS12
Aluminum	AL	ICP	11.2	JS12	112	SS12
Arsenic	AS	GFAA	2.50	B9	2.35	AX8
Barium	BA	ICP	3.29	JS12	2.82	SS12
Beryllium	BE	ICP	0.43	JS12	1.12	SS12
Calcium	CA	ICP	25.3	JS12	105	SS12
Cadmium	CD	ICP	1.20	JS12	6.78	SS12
Cobalt	CO	ICP	2.50	JS12	25.0	SS12
Chromium	CR	ICP	1.04	JS12	16.8	SS12
Copper	CU	ICP	2.84	JS12	18.8	SS12
Cyanide	CYN	Colorimetric	0.25	KF15/KY15	5.0	TF34/TY23
Iron	FE	ICP	6.66	JS12	77.5	SS12
Mercury	HG	CVAA	0.05	Y9	0.10	CC8
Potassium	K	ICP	131	JS12	1240	SS12
Magnesium	MG	ICP	10.1	JS12	135	SS12
Manganese	MN	ICP	9.87	JS12	9.67	SS12
Sodium	NA	ICP	38.7	JS12	279	SS12
Nickel	NI	ICP	2.74	JS12	32.1	SS12
Lead	PB	ICP	7.44	JS12	43.4	SS12
Antimony	SB	ICP	19.6	JS12	60.0	SS12
Antimony	SB	GFAA	1.0 [a]	7041	10.0 [b]	7041
Selenium	SE	GFAA	0.45	JD20	2.53	SD25
Thallium	TL	ICP	34.3	JS12	125	SS12
Thallium	TL	GFAA	1.0 [c]	7471	10.0 [d]	7871
Vanadium	V	ICP	1.41	JS12	27.6	SS12
Zinc	ZN	ICP	2.34	JS12	18.0	SS12
Pesticides						
alpha-BHC	ABHC	GCEC	0.0028	LH17	0.0025	UH20
alpha-Endosulfan	AENSLF	GCEC	0.0010	LH17	0.0025	UH20
Aldrin	ALDRN	GCEC	0.0014	LH17	0.0074	UH20

Table 2-3. Summary of Analytical Methods (continued)

Parameter	Code	Method Type[(a)]	Soil CRL[(b)] (μg/g)[(c)]	Soil Method Number	Water CRL (μg/L)[(d)]	Water Method Number
beta-BHC	BBHC	GCEC	0.0077	LH17	0.0099	UH20
beta-Endosulfan	BENSLF	GCEC	0.0007	LH17	0.0077	UH20
Chlordane	CLDAN	GCEC	0.0684	LH17	0.0312	UH20
delta-BHC	DBHC	GCEC	0.0085	LH17	0.0034	UH20
Dieldrin	DLDRN	GCEC	0.0016	LH17	0.0074	UH20
Endrin	ENDN	GCEC	0.0065	LH17	0.176	UH20
Endrin aldehyde	ENDRNA	GCEC	0.0005[(e)]	LH17	0.0504	UH20
Endrin ketone	ENDRNK	GCEC	0.0005[(e)]	LH17	0.0025[(e)]	UH20
Endosulfan sulfate	ESFS04	GCEC	0.0005[(e)]	LH17	0.0025[(e)]	UH20
Heptachlor	HPCL	GCEC	0.0022	LH17	0.0025	UH20
Heptachlor epoxide	HPCLE	GCEC	0.0013	LH17	0.0063	UH20
Isodrin	ISODR	GCEC	0.0030	LH17	0.0025	UH20
Lindane/gamma-BHC	LIN	GCEC	0.0010	LH17	0.0025	UH20
Methoxychlor	MEXCLR	GCEC	0.0359	LH17	0.0750	UH20
2,2-Bis(p-chlorophenyl)-1,1-dichloroethane	PPDDD	GCEC	0.0027	LH17	0.0081	UH20
2,2-Bis(p-chlorophenyl)-1,1-dichloroethene	PPDDE	GCEC	0.0027	LH17	0.0039	UH20
2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane	PPDDT	GCEC	0.0035	LH17	0.0025	UH20
Toxaphene	TXPHEN	GCEC	0.2260	LH17	1.64	UH20
Volatiles						
1,1,1-Trichloroethane	111TCE	GCMS	0.200	LM23	1.00	UM21
1,1,2-Trichloroethane	112TCE	GCMS	0.330	LM23	1.00	UM21
1,1-Dichloroethene	11DCE	GCMS	0.270	LM23	1.0	UM21
1,1-Dichloroethane	11DCLE	GCMS	0.490	LM23	1.0	UM21
1,2-Dichloroethane-D4	12DCD4	GCMS	0.500	LM23	2.0	UM21
1,2-Dichloroethene (total)	12DCE	GCMS	0.320	LM23	5.0	UM21
1,2-Dichloropropane	12DCLP	GCMS	0.530	LM23	1.0	UM21
1,3-Dichlorobenzene	13DCLB[(f)]	GCMS	0.140	LM23	1.0	UM21
1,3-Dichloropropane	13DCP	GCMS	0.200	LM23	4.80	UM21
1,3-Dimethylbenzene	13DMB[(g)]	GCMS	0.230	LM23	1.0	UM21

Table 2-3. Summary of Analytical Methods (continued)

Parameter	Code	Method Type[a]	Soil CRL[b] (µg/g)[c]	Soil Method Number	Water CRL (µg/L)[d]	Water Method Number
2-Chloroethylvinyl ether	2CLEVE	GCMS	0.500	LM23	3.50	UM21
Acetone	ACET	GCMS	3.300	LM23	8.0	UM21
Bromodichloromethane	BRDCLM	GCMS	0.200	LM23	1.0	UM21
cis-1,3-dichloropropene	C13DCP	GCMS	0.6[e]	LM23	5.0[e]	UM21
Vinyl acetate	C2AVE	GCMS	1.0[e]	LM23	1.0[e]	UM21
Vinyl chloride/Chloroethene	C2H3CL	GCMS	1.800	LM23	12.00	UM21
Chloroethane	C2H5CL	GCMS	0.640	LM23	8.00	UM21
Benzene	C6H6	GCMS	0.100	LM23	1.00	UM21
Carbon tetrachloride	CCL4	GCMS	0.310	LM23	1.00	UM21
Methylene Chloride-D2	CD2CL2	GCMS	2.400	LM23	9.70	UM21
Methylene Chloride/Dichloromethane	CH2CL2	GCMS	4.400	LM23	1.00	UM21
Bromomethane	CH3BR	GCMS	0.260	LM23	14.00	UM21
Chloromethane	CH3CL	GCMS	0.960	LM23	1.20	UM21
Bromoform	CHBR3	GCMS	0.200	LM23	11.00	UM21
Chloroform	CHCL3	GCMS	0.240	LM23	1.00	UM21
Chlorobenzene	CLC6H5	GCMS	0.100	LM23	1.00	UM21
Carbon disulfide	CS2	GCMS	0.60[e]	LM23	5.0[e]	UM21
Dibromochloromethane/ Chlorodibromomethane	DBRCLM	GCMS	0.250	LM23	1.00	UM21
Dichlorobenzene	DCLB[f]	GCMS	0.200	LM23	2.00	UM21
Ethylbenzene-D10	ETBD10	GCMS	0.100	LM23	1.00	UM21
Ethylbenzene	ETC6H5	GCMS	0.190	LM23	1.00	UM21
Toluene-D8	MEC6D8	GCMS	0.100	LM23	1.00	UM21
Toluene	MEC6H5	GCMS	0.100	LM23	1.00	UM21
2-Butanone/methyl ethyl ketone	MEK	GCMS	4.30	LM23	10.0	UM21
Methyl-iso-butyl ketone/ 4-Methyl-2-pentanone	MIBK	GCMS	0.630	LM23	1.40	UM21
2-Hexanone/Methyl-n-butylketone	MNBK	GCMS	1.0[e]	LM23	1.0[e]	UM21
Styrene/Vinyl benzene	STYR	GCMS	0.6[e]	LM23	5.0[e]	UM21
trans-1,3-Dichloropropene	T13DCP	GCMS	0.6[e]	LM23	5.00[e]	UM21

Table 2-3. Summary of Analytical Methods (continued)

Parameter	Code	Method Type[a]	Soil CRL[b] (μg/g)[c]	Soil Method Number	Water CRL (μg/L)[d]	Water Method Number
1,1,2,2-Tetrachloroethane	TCLEA	GCMS	0.200	LM23	1.50	UM21
Tetrachloroethylene	TCLEE	GCMS	0.160	LM23	1.00	UM21
Trichloroethylene	TRCLE	GCMS	0.230	LM23	1.00	UM21
Xylene	XYLEN[g]	GCMS	0.780	LM23	2.00	UM21
<u>Semivolatiles</u>						
1,2,4-Trichlorobenzene	124TCB	GCMS	0.2200	LM25	2.40	UM25
1,2-Dichlorobenzene	12DCLB	GCMS	0.0420	LM25	1.20	UM25
1,3-Dichlorobenzene-D4	13DBD4	GCMS	0.0500	LM25	14.00	UM25
1,3-Dichlorobenzene	13DCLB	GCMS	0.0420	LM25	3.40	UM25
1,4-Dichlorobenzene	14DCLB	GCMS	0.0340	LM25	1.50	UM25
2,4,5-Trichlorophenol	245TCP	GCMS	0.4900	LM25	2.80	UM25
2,4,6-Trichlorophenol	246TCP	GCMS	0.0610	LM25	3.60	UM25
2,4-Dichlorophenol	24DCLP	GCMS	0.0650	LM25	8.40	UM25
2,4-Dimethylphenol	24DMPN	GCMS	3.0000	LM25	4.40	UM25
2,4-Dinitrophenol	24DNP	GCMS	4.7000	LM25	176.00	UM25
2,4-Dinitrotoluene	24DNT	GCMS	1.4000	LM25	5.80	UM25
2,6-Dinitrotoluene	26DNT	GCMS	0.3200	LM25	6.70	UM25
2-Chlorophenol	2CLP	GCMS	0.0550	LM25	2.80	UM25
2-Chlorophenol-D4	2CLPD4	GCMS	0.3500	LM25	47.00	UM25
2-Chloronaphthalene	2CNAP	GCMS	0.2400	LM25	2.60	UM25
2-Methylnaphthalene	2MNAP	GCMS	0.0320	LM25	1.30	UM25
2-Methylphenol/o-Cresol	2MP	GCMS	0.0980	LM25	3.60	UM25
2-Nitroaniline	2NANIL	GCMS	3.10[e]	LM25	31.0[e]	UM25
2-Nitrophenol	2NP	GCMS	1.1000	LM25	8.20	UM25
3,3-Dichlorobenzidine	33DCBD	GCMS	1.6000	LM25	5.00	UM25
3-Nitroaniline	3NANIL	GCMS	3.0000	LM25	15.00	UM25
3-Nitrotoluene	3NT	GCMS	0.3400	LM25	2.90	UM25
4,6-Dinitro-2-cresol/ 4,6-Dinitro-o-cresol	46DN2C	GCMS	0.8000	LM25	50.00[e]	UM25
4-Bromophenyl phenyl ether	4BRPPE	GCMS	0.0410	LM25	22.00	UM25
4-Chloroaniline	4CANIL	GCMS	0.63[e]	LM25	1.0[e]	UM25

Table 2-3. Summary of Analytical Methods (continued)

Parameter	Code	Method Type[a]	Soil CRL[b] (µg/g)[c]	Soil Method Number	Water CRL (µg/L)[d]	Water Method Number
3-Methyl-4-chlorophenol/ 4-Chloro-m-cresol/4-Chloro-3-cresol/4-Chloro-3-methylphenol	4CL3C	GCMS	0.9300	LM25	8.50	UM25
4-Chlorophenyl phenyl ether	4CLPPE	GCMS	0.1700	LM25	23.00	UM25
4-Methylphenol/p-Cresol	4MP	GCMS	0.2400	LM25	2.80	UM25
4-Nitroaniline	4NANIL	GCMS	3.10[e]	LM25	31.0[e]	UM25
4-Nitrophenol	4NP	GCMS	3.3000	LM25	96.00	UM25
alpha-BHC	ABHC	GCMS	1.3000	LM25	5.30	UM25
alpha-Endosulfan	AENSLF	GCMS	0.4000	LM25	23.00	UM25
Aldrin	ALDRN	GCMS	1.3000	LM25	13.00	UM25
Acenaphthene	ANAPNE	GCMS	0.0410	LM25	5.80	UM25
Acenaphthylene	ANAPYL	GCMS	0.0330	LM25	5.10	UM25
Aniline	ANIL	GCMS	0.1300[e]	LM25	2.00[e]	UM25
Anthracene	ANTRC	GCMS	0.7100	LM25	5.20	UM25
Bis(2-chloroethoxy)methane	B2CEXM	GCMS	0.1900	LM25	6.80	UM25
Bis(2-chloroisopropyl)ether	B2CIPE	GCMS	0.4400	LM25	5.00	UM25
Bis(2-chloroethyl)ether	B2CLEE	GCMS	0.3600	LM25	0.68	UM25
Bis(2-ethylhexyl)phthalate	B2EHP	GCMS	0.4800	LM25	7.70	UM25
Benzo[A]anthracene	BAANTR	GCMS	0.0410	LM25	9.80	UM25
Benzo[A]pyrene	BAPYR	GCMS	1.2000	LM25	14.00	UM25
Benzo[B]fluoranthene	BBFANT	GCMS	0.3100	LM25	10.00	UM25
beta-BHC	BBHC	GCMS	1.3000	LM25	17.00	UM25
Butylbenzyl phthalate	BBZP	GCMS	1.8000	LM25	28.00	UM25
beta-Endosulfan	BENSLF	GCMS	2.4000	LM25	42.00	UM25
Benzidine	BENZID	GCMS	0.1300[e]	LM25	2.00[e]	UM25
Benzoic acid	BENZOA	GCMS	3.10[e]	LM25	3.10[e]	LM25
Benzo[G,H,I]perylene	BGHIPY	GCMS	0.1800	LM25	15.00	UM25
Benzo[K]fluoranthene	BKFANT	GCMS	0.1300	LM25	10.00	UM25
Benzyl alcohol	BZALC	GCMS	0.0320	LM25	4.00	UM25
Chrysene	CHRY	GCMS	0.0320	LM25	7.40	UM25
Hexachlorobenzene	CL6BZ	GCMS	0.0800	LM25	12.00	UM25

Table 2-3. Summary of Analytical Methods (continued)

Parameter	Code	Method Type[a]	Soil CRL[b] (μg/g)[c]	Soil Method Number	Water CRL (μg/L)[d]	Water Method Number
Hexachlorocyclopentadiene	CL6CP	GCMS	0.5200	LM25	54.00	UM25
Hexachloroethane	CL6ET	GCMS	1.8000	LM25	8.30	UM25
Chlordane	CLDAN	GCMS	0.6800	LM25	37.00	UM25
Dibenz[A,H]anthracene	DBAHA	GCMS	0.03100	LM25	12.00	UM25
delta-BHC	DBHC	GCMS	0.2100	LM25	—[h]	—[h]
Dibenzofuran	DBZFUR	GCMS	0.0380	LM25	5.10	UM25
Diethyl phthalate	DEP	GCMS	0.2400	LM25	5.90	UM25
Diethyl phthalate-D4	DEPD4	GCMS	0.0600	LM25	8.70	UM25
Dieldrin	DLDRN	GCMS	0.0790	LM25	26.00	UM25
Dimethyl phthalate	DMP	GCMS	0.0630	LM25	2.20	UM25
Di-N-butyl phthalate	DNBP	GCMS	1.3000	LM25	33.00	UM25
Di-N-octyl phthalate	DNOP	GCMS	0.2300	LM25	1.50	UM25
Di-N-octyl phthalate-D4	DNOPD4	GCMS	0.0650	LM25	13.00	UM25
Endrin	ENDRN	GCMS	1.3000	LM25	18.00	UM25
Endrin aldehyde	ENDRNA	GCMS	1.8000	LM25	5.00	UM25
Endosulfan sulfate	ESFSO4	GCMS	1.2000	LM25	50.0	UM25
Fluoranthene	FANT	GCMS	0.0320	LM25	24.00	UM25
Fluorene	FLRENE	GCMS	0.0650	LM25	9.20	UM25
Hexachloro-1,3-butadiene	HCBD	GCMS	0.9700	LM25	8.70	UM25
Heptachlor	HPCL	GCMS	0.2400	LM25	38.00	UM25
Heptachlor epoxide	HPCLE	GCMS	0.4800	LM25	28.00	UM25
Ideno[1,2,3-C,D]pyrene	ICDPYR	GCMS	2.4000	LM25	21.00	UM25
Isodrin	ISODR	GCMS	0.4800	LM25	7.80	UM25
Isophorone	ISOPHR	GCMS	0.3900	LM25	2.40	UM25
Lindane/gamma-BHC	LIN	GCMS	0.1000	LM25	7.20	UM25
Methoxychlor	MEXCLR	GCMS	0.2600	LM25	11.00	UM25
Naphthalene	NAP	GCMS	0.7400	LM25	0.50	UM25
Nitrobenzene	NB	GCMS	1.8000	LM25	3.70	UM25
Nitrobenzene-D5	NBD5	GCMS	0.2200	LM25	26.00	UM25
N-Nitroso-dimethylamine	NNDMEA	GCMS	0.460	LM25	9.70	UM25
N-Nitroso-di-N-propylamine	NNDNPA	GCMS	1.1000	LM25	6.80	UM25

Table 2-3. Summary of Analytical Methods (continued)

Parameter	Code	Method Type[a]	Soil CRL[b] (μg/g)[c]	Soil Method Number	Water CRL (μg/L)[d]	Water Method Number
N-Nitroso-diphenylamine	NNDPA	GCMS	0.2900	LM25	3.70	UM25
Polychlorinated biphenyl-arochlor 1016	PCB016	GCMS	0.3200	LM25	—[h]	—[h]
Polychlorinated biphenyl-arochlor 1260	PCB260	GCMS	0.7900	LM25	—[h]	—[h]
Polychlorinated biphenyl-arochlor 1262	PCB262	GCMS	6.3000	LM25	—[h]	—[h]
Pentachlorophenol	PCP	GCMS	0.7600	LM25	9.10	UM25
Phenanthrene	PHANTR	GCMS	0.0320	LM25	9.90	UM25
Phenol-D6	PHEND6	GCMS	0.0690	LM25	34.00	UM25
Phenol	PHENOL	GCMS	0.0520	LM25	2.20	UM25
2,2-Bis(p-chlorophenyl)-1,1-dichloroethane	PPDDD	GCMS	0.0640	LM25	18.00	UM25
2,2-Bis(p-chlorophenyl-1,1-dichloroethene	PPDDE	GCMS	0.0680	LM25	14.00	UM25
2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane	PPDDT	GCMS	0.1000	LM25	18.00	UM25
Pyrene	PYR	GCMS	0.0830	LM25	17.00	UM25
Toxaphene	TXPHEN	GCMS	12.0000	LM25	—[h]	—[h]
Explosives						
1,3,5-Trinitrobenzene	135TNB	HPLC	0.9220	LW23	0.2100	UW25
1,3-Dinitrobenzene	13DNB	HPLC	0.5040	LW23	0.4580	UW25
2,4,6-Trinitrotoluene	246TNT	HPLC	2.0000	LW23	0.4260	UW25
2,4-Dinitrotoluene	24DNT	HPLC	2.5000	LW23	0.3970	UW25
2,6-Dinitrotoluene	26DNT	HPLC	2.0000	LW23	0.6000	UW25
Cyclotetramethylene-tetranitramine	HMX	HPLC	2.0000	LW23	0.5330	UW25
Nitrobenzene	NB	HPLC	1.1400	LW23	0.6820	UW25
Cyclonite	RDX	HPLC	1.2800	LW23	0.4160	UW25
Nitramine	TETRYL	HPLC	2.1100	LW23	0.6310	UW25
PCBs						
PCB 1016	PCB016	GCEC	0.100	LH17	0.385	UH20
PCB 1221	PCB221	GCEC	—[i]	LH17	—[i]	UH20
PCB 1232	PCB232	GCEC	—[i]	LH17	—[i]	UH20

Table 2-3. *Summary of Analytical Methods (continued)*

Parameter	Code	Method Type[a]	Soil CRL[b] (µg/g)[c]	Soil Method Number	Water CRL (µg/L)[d]	Water Method Number
PCB 1242	PCB242	GCEC	—[i]	LH17	—[i]	UH20
PCB 1248	PCB248	GCEC	—[i]	LH17	—[i]	UH20
PCB 1254	PCB254	GCEC	—[i]	LH17	—[i]	UH20
PCB 1260	PCB260	GCEC	0.479	LH17	0.176	UH20
Dioxins/Furans						
Total Tetrachlorodibenzodioxins	TCDDs (Total)	High-Res. GC-MS	0.30 pg/g[j]	8290	2.0 pg/L[k]	8290
2,3,7,8-Tetrachlorodibenzodoxins	2,3,7,8-TCDD	High-Res. GC-MS	0.19 pg/g	8290	2.0 pg/L	8290
Total Pentachlorodibenzodioxins	PeCDDs (Total)	High-Res. GC-MS	1.9 pg/g	8290	19 pg/L	8290
1,2,3,7,8-Pentachlorodibenzodioxin	1,2,3,7,8-PeCDD	High-Res. GC-MS	0.38 pg/g	8290	4.2 pg/L	8290
Total Hexachlorodibenzodioxins	HxCDDs (Total)	High-Res. GC-MS	0.24 pg/g	8290	2.9 pg/L	8290
1,2,3,4,7,8-Hexachlorodibenzodioxin	1,2,3,4,7,8-HxCDD	High-Res. GC-MS	0.24 pg/g	8290	2.9 pg/L	8290
1,2,3,6,7,8-Hexachlorodibenzodioxin	1,2,3,6,7,8-HxCDD	High-Res. GC-MS	0.23 pg/g	8290	2.7 pg/L	8290
1,2,3,7,8,9-Hexachlorodibenzodioxin	1,2,3,7,8,9-HxCDD	High-Res. GC-MS	0.23 pg/g	8290	2.8 pg/L	8290
Total Heptachlorodibenzodioxins	HpCDDs (Total)	High-Res. GC-MS	0.30 pg/g	8290	2.6 pg/L	8290
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	1,2,3,4,6,7,8-HpCDD	High-Res. GC-MS	0.25 pg/g	8290	2.6 pg/L	8290
Octachlorodibenzodioxin	OCDD	High-Res. GC-MS	1.2 pg/g	8290	7.0 pg/L	8290
1,2,3,4,7,8,9-Heptachlorodibenzofuran	1,2,3,4,7,8,9-HpCDF	High-Res. GC-MS	0.13 pg/g	8290	1.5 pg/L	8290
Octachlorodibenzofuran	OCDF	High-Res. GC-MS	0.32 pg/g	8290	3.6 pg/L	8290
Anions						
Nitrate/Nitrite	NIT	Colorimetric	1.00	KF17	10.0	LL8
Perchlorate	PER	IC	5.0	—	0.5[l]	—
Sulfate	SO4	IC	5.0	KT07	175	TT09

Table 2-3. Summary of Analytical Methods (continued)

Parameter	Code	Method Type[a]	Soil CRL[b] ($\mu g/g$)[c]	Soil Method Number	Water CRL ($\mu g/L$)[d]	Water Method Number
Propellant Suite						
Nitrocellulose	NC	Colorimetric	2.3	LF05	23.1	UF05
Nitroglycerin	NG	HPLC	0.51	LW27	1.49	UW27
Nitroguanidine	HQ	HPLC	0.0447	LW30	21.1	UW29
PETN	PETN	GC/MS	1.00	LW27	2.00	UW27
Bis(2-ethylhexyl) phthalate	B2EHP	GC/MS	0.48	LM25	7.7	UM25
Butyl benzyl phthalae	BBZP	GC/MS	1.8	LM25	28	UM25
Diethyl phthalate	DEP	GC/MS	0.24	LM25	5.9	UM25
Dimethyl phthalate	DMP	GC/MS	0.063	LM25	2.2	UM25
Di-n-butyl phthalate	DNBP	GC/MS	1.3	LM25	33	UM25
Di-n-octyl phthalate	DNOP	GC/MS	0.23	LM25	1.5	UM25
Diphenylamine[m]	DPA	GC/MS	—	LM25	—	UM25
Ethyl centralite[n]	SMDIUR	HPLC	2.5	ECNS	5.0	ECNW

[a]Abbreviations for method types are GC/MS=gas chromatography/mass spectroscopy, GC/ECD=gas chromatography/electron capture detector, ICP=inductively coupled/plasma, CVAA=cold vapor atomic absorption, HPLC=high pressure liquid chromatography, GFAA=graphite furnace atomic absorption.

[b]Certified reporting limit.

[c]Micrograms per gram, ppm.

[d]Micrograms per liter, ppb.

[e]Method is not certified for this analyte. Laboratory detection limit is presented.

[f]1,2-dichlorobenzene and 1,4-dichlorobenzene coelute as DCLB; 1,3-dichlorobenzene is analyzed as 13DCLB.

[g]1,2-dimethylbenzene and 1,4-dimethylbenzene coelute as xylene; 1,3-dimethyl benzene is analyzed as 13DMB.

[h]No certified reporting limit for this analyte in water. Pesticide and PCB analysis is provided by Method UH20.

[i]The other, non-certified PCBs are based on relative data for PCB-1016 and PCB-1260.

[j]Picograms per gram, equivalent to parts per trillion.

[k]Picograms per liter, equivalent to parts per quadrillion.

[l]Method not certified; value is limit of detection (LOD). Analysis followed DataChem Laboratory internal SOP.

[m]Diphenylamine was analyzed as n-nitrosodiphenylamine (NNDPA) by LM 25 (SVOCs in soil) with an estimated CRL =0.29 μg/g, and by UM25 (SVOCs in water) with an estimated CRL=3.7 μg/L with confirmation by evaluation of mass spectrum.

[n]Ethyl centralite contains diethyl diphenyl urea (CAS #85-98-3); method development for this analyte was necessary because it is not included in the standard analyte suite for HPLC analysis.

Table 2-4. Comparison of USAEC Data Qualifiers to USEPA Data Qualifiers

USAEC Data Qualifiers[a]		USEPA Data Qualifiers Assigned[b]	
I	The low-spike recovery is high.	**J**	Analyte present. Reported values below the concentration of the high-spike are estimates that may or may not be accurate or precise. Non-detected analytes are not qualified.
J	The low-spike recovery is low.	**J**	Analyte present. Reported values below the concentrations of the high-spike are estimates that may or may not be accurate or precise.
		UJ	Not detected. Detection limit may be inaccurate or imprecise and may not be equal to certified reporting limit.
M	The high-spike recovery is high.	**J**	Analyte present. Reported values above the concentration of the low-spike are estimates thay may or may not be precise. Non-detected analytes are not qualfied.
N	The high-spike recovery is low.	**J**	Analyte present. Reported values above the concentration of the low-spike are estimates thay may or may not be accurate or precise. Non-detected analytes are not qualified unless low concentration spike is below control limits.
K	Missed holding time for extraction and preparation.	**J**	Analyte present. Reported value is an estimate that may or may not be accurate or precise.
		UJ	Not detected. Detection limit may be inaccurate or imprecise and may not be equal to certified reporting limit.
R	Data is rejected. (Used alone or in combination with above codes).	**R**	Sample results rejected. The presence or absence of the analyte cannot be verified.

[a]Only those USAEC data qualifiers used for Phase I and Phase II RI data are included in this table.

[b]USEPA data qualifiers were assigned to data qualified by USAEC or by EcoChem during validation activities in tables in Appendix J. These tables are designed to aid in the interpretation of USEPA versus USAEC qualifiers.

2.4.4 Sample Data Quality Assurance/Quality Control

This section consists of a discussion of the laboratory and field QA/QC samples that were collected and of the analytical results.

2.4.4.1 *Laboratory Quality Assurance/Quality Control*

USAEC laboratory quality assurance/quality control (QA/QC) procedures, as described in the *Quality Assurance Plan* (QAP) (USATHAMA 1990), consist of the preparation and analysis of method blanks, laboratory QC spikes, and matrix spike/matrix spike duplicates (MS/MSDs). These samples were analyzed with the actual field samples to evaluate the quality of the resulting analytical data. Results for all laboratory QC samples as well as the field QC samples are presented in Appendix I. A discussion of the laboratory QC procedures used to evaluate the analytical data generated for this RIA is presented below.

The amount of QC data available for evaluation from the 1992 Phase I field investigations was very limited. Due to the ambiguity in the use of "99" for the method on the earlier data (i.e., "rejected lot" vs "non-THAMA" method), no data having a method "99" were evaluated for QC performance. In addition, relative percent differences (RPDs) were not calculated for data that were not easily recognized as MS/MSD pairs.

2.4.4.1.1 ***Method Blanks.*** Method blanks under the USAEC analytical program consist of ASTM Type II water or organic solvents, Rocky Mountain Arsenal (RMA) standard soil (for soil methods), and any other reagents which are included as samples in the sample lots to identify contamination that may have been introduced during sample preparation and analysis. One method blank is included with each lot. Analytes detected above CRLs in the method blank were used to distinguish actual site contamination from potential laboratory contamination. Method blank data were compared with results from samples with which the blanks were associated. For common laboratory contaminants (i.e., acetone, methyl ethyl ketone, methylene chloride, toluene, and the phthalate esters), sample results were considered valid only if the concentration in the sample exceeded 10 times the amount detected in the corresponding method blank (USEPA 1989a). For analytes not considered to be common laboratory contaminants, sample results were considered valid only if the concentration in the sample exceeded 5 times the amount detected in the corresponding method blank (USEPA 1989a).

Table 2-5 presents the analytes detected in method blanks that were used to evaluate the sampling results for the RI Phase II 1994 data. Method blanks are reported in either μg/g (ppm, soil method) or μg/L (ppb, water method). The pesticide, endosulfan sulfate, flagged "ZU", was present in two method blanks, one of which was associated with SWMU 35 and the other with equipment rinses. Delta-benzenehexachloride (DBHC) was detected in one method blank associated with equipment rinses only and was flagged with a "U." Four other organics (1,1,1-trichloroethane, 1,1,2,2-tetrachloroethane, di-n-butyl phthalate, and methyl-isobutyl

Table 2-5. Summary of Analytes Detected in Method Blanks (Phase II 1994 Data)

Analyte	SWMU	Range	Comment
Metals			
Aluminum	All	647 - 1,220	
Barium	All	5.7 - 10.8	
Calcium	All	169 - 323	
Chromium	All except 13, 32, and 35	1.13 - 1.69	
Iron	All	835 - 1,730	
Mercury	23	0.61	
Potassium	All	155 - 320	
Magnesium	All	115 - 221	
Manganese	All	15.2 - 31.5	
Nickel	13, 23	7.84	
Vanadium	All	1.56 - 3.74	
Zinc	All except 32	2.72 - 6.69	
		37.8 - 47.9 μg/L	
Pesticides			
delta-BHC	Equipment rinses	0.00364 μg/L	Flag code "U"
Endosulfan sulfate	35 and equipment rinses	0.00564 - 0.012 μg/L	Flag code "ZU"
SVOCs			
Di-n-butyl phthalate	7	3.2	
VOCs			
Methyl isobutyl ketone	13	1.1	
1,1,1-trichloroethane	35	3.9 μg/L	
1,1,2,2-tetrachloroethane	13	0.22	
Explosives			
1,3,5-trinitrobenzene	Equipment rinses	0.396 μg/L	Flag code "U7"

Note.—Unless otherwise noted, units are in μg/g, equivalent to parts per million; μg/L equivalent to ppb.

ketone) were detected at low concentrations in method blanks associated with SWMUs 35, 13, 7, and 13, respectively. An explosive, 1,3,5-trinitrobenzene, was detected in one method blank associated with equipment rinses but was also flagged "U7." The metals aluminum, barium, calcium, iron, magnesium, manganese, potassium, and vanadium were present at detectable concentrations at all 11 SWMUs. Chromium, mercury, nickel, and zinc were also detected in various method blanks, but at a much lower frequency. Table 2-6 presents the summary of analytes detected in method blanks analyzed with samples collected during 1995 field activities. Preparation of method blanks under the USAEC program includes the use of RMA soil (for soil methods) as the matrix carried through the extraction and analysis steps. The presence of metals in that soil may well account for all metal detects in the method blanks. The remaining analytes in the method blanks may be attributed to low level laboratory contamination (endosulfan sulfate), the low SVOCs and VOCs. According to DataChem, the very high method blank for nitrocellulose (1995 data) is apparently typical for this method, which is known to be very problematic. The use of RMA soil may be a cause for matrix interferences which could contribute to the high blank value. Low levels of dioxin/furans in method blanks are fairly usual in the laboratories performing ultra-trace determinations such as Method 8290. In that method, sodium sulfate is often the matrix used for the method blank.

Due to the limited amount of field QC in the Phase I data, an in-depth review of the laboratory QC was not conducted; however, where possible, data were evaluated. Detects in method blanks for soil methods included anions (bromide, nitrate, phosphate, and sulfate), iron, a few SVOCs, and three VOCs (1,4-dichlorobenzene, acetone and methylene chloride). The average anion concentration was 23 ppm; iron had only one detect at 3.6 ppm; the average SVOC concentraton was 0.22 μg/g, and the mean VOC concentration was 0.007 μg/g.

Detects in the method blanks analyzed for the water methods included acetone, methylene chloride, mercury (0.68 μg/L), OCDD (0.001 μg/L and 0.0004 μg/L), and tetrachloroethylene at 0.38 μg/L. Chloride and sulfate were reported as "GT" with concentrations of 200 μg/L and 500 μg/L, respectively.

2.4.4.1.2 ***Laboratory Quality Control Spikes.*** To verify method performance and provide information on analytical method accuracy and precision, the laboratory was required to analyze laboratory quality control spike samples (QC spikes). Three QC spikes, also referred to as standard matrix spikes (or laboratory control samples (LCS), were required for each analytical batch: one spiked at twice the concentration of the lower CRL for the method and the other two samples spiked at 10 times the concentration of the lower CRL for the method. Field samples were bracketed by the QC spikes during the actual analysis run, low spike analyzed initially, followed by the field samples, and then analysis of the two high spikes. The LCS spike recovery data (i.e., percent R) were plotted on "control charts" to determine if resulting recoveries were within acceptance tolerance ranges as set by USAEC. The "control charts" were also used to record results from the evaluation of method-specific holding times.

These control charts, for each lot of sample data using USAEC methods, were submitted to the USAEC Chemistry Branch for review and approval. Approval was received in the form of a

Table 2-6. Summary of Analytes Detected in Method Blanks (Phase II 1995 Data)

Analyte	SWMU	Range	Average
Metals			
Aluminum	6, 8, 40	—	2 (750)
Barium	6, 8, 40	—	2 (8.4)
Calcium	6, 8, 40	—	2 (243)
Chromium	6, 8, 40	—	1 (1.1)
Iron	6, 8, 40	—	2 (1, 184)
Potassium	6, 8, 40	—	2 (223)
Magnesium	6, 8, 40	—	2 (154)
Manganese	6, 8, 40	—	2 (24.3)
Vanadium	6, 8, 40	—	2 (2.3)
Zinc	6, 8, 40	—	2 (3.1)
Dioxins/Furans			
Total Furans			
Water Matrix	6	1.92E-06 - 3.24E-06	2.58E-06
Soil Matrix	6	1.3E-07 - 5.36 E-06	2.44E-06
Total Dioxins			
Soil Matrix	6	2.0E-06 - 1.2E-05	5.6E-06
Water Matrix	6	4.3E-06 (78 PCDD only)	—
Explosives/Propellants			
Nitrocellulose (soil)	40	1 (86.7)	—

Note.—Units are in $\mu g/g$ (equivalent to ppm) for soil or $\mu g/L$ (equivalent to ppb) for water. The number of detects are shown, followed in parentheses by the average concentration .

"Control Chart Letter" prepared by the Chemistry Branch that either approved the lot without comment, approved the lot only with appropriate flagging codes and qualifiers, or rejected the lot. The qualifying codes specified by the Chemistry Branch are entered with the data on the IRDMIS database. Rejected data for an entire lot or a specific analyte within the lot receive an "R" qualifier code. Standard matrix spikes are presented in Appendix I, and the sample data results, including appropriate flags and qualifiers as required, are presented in Appendix H. Discussion of qualified or rejected data and of the impact on data evaluation is presented with individual SWMUs. Due to the very large amount of analytical data associated with the Phase II RI 1994 data, only the 1995 percent recovery data are summarized below in Table 2-7. Only percent recoveries for spiked *target* analytes are included in Table 2-7, not internal standard or surrogate recoveries. Except for some low explosives and SVOC recoveries, the average %Rs indicate overall acceptable method performance and analytical accuracy. Standard matrix spikes (LCS) are not analyzed with USEPA SW-846 Method 8290 for dioxins/furans.

The standard spike recoveries for the Phase I data are presented in Table 2-8. For the data that could be properly evaluated, the results indicate that the laboratory (Arthur D. Little) followed the analytical methods and the recoveries were generally acceptable. The mean recoveries for SVOCs in both water and soil tended to be lower than for the other chemical classes.

2.4.4.1.3 ***Matrix Spike/Matrix Spike Duplicates.*** MS/MSDs were analyzed in conjunction with blanks and replicates to provide quality control for the analytical methods used. The MS/MSDs were used to provide information regarding sample matrix effects and the capability of different methods to efficiently extract analytes of interest. One MS/MSD pair was prepared by the laboratory and analyzed with each lot, although they are not required under the USAEC analytical program. The MS/MSDs are actual field samples split three ways, one control sample and two duplicate samples. The control sample is analyzed, and the result is used to establish the amount of analyte actually present in the field sample.

This concentration can then be used to subtract from the concentration obtained for the two spiked samples to establish a percent recovery for that particular analyte in that matrix. In addition, the RPD for the two spikes can also be estimated. These two factors, the percent recovery and the RPD, are used to assess the precision of the analytical method. The MS/MSD results (natural matrix spikes) are presented in Appendix I. RPDs for the 1994, 1995, and 1992 Phase I data are presented in Sections 2.5.2.2.1 and 2.5.2.2.2.

Each USEPA analytical method has established ranges of performance, and USEPA-Contract Laboratory Program (CLP)-certified laboratories are required to continually evaluate method-specific results of MS/MSDs to determine precision and accuracy criteria for utilized methods. Based on these results, laboratory- and method-specific performance characteristics can be compared to USEPA method performance criteria. This approach is also utilized by USAEC for establishing upper and lower control chart limits.

Table 2-7. Summary of Percent Recoveries for Standard Matrix Spikes (1995 Phase II Data)

SWMU	Description	Chemical Class	Range (%R)
40	AED Test Range	Cyanide	
		soil matrix	84.4 - 94.8
		water matrix	98.0 - 103
		Anions	
		soil matrix	80.6 - 100
		water matrix	93.0 - 100
		Ethyl Centralite	
		soil matrix	82.8
		water matrix	87.6
6 & 40	Old Burn/AED Test Range	Explosives	
		soil matrix	85.6 - 130
		water matrix	56.1 - 132
40	AED Test Range	Nitrocellulose	
		soil matrix	67.9 - 89.4
		water matrix	78.8 - 91.7
		Nitroglycerine	
		soil matrix	93.5 - 101
		water matrix	91.3 - 98.6
		Nitroguanidine	
		soil matrix	105.4 - 120
		water matrix	99.4 - 126
		PETN[(a)]	
		soil matrix	94.5 - 98.5
		water matrix	98.1 - 112
		SVOCs[(b)]	
		soil matrix	70.0 - 118
		water matrix	38.0 - 130
6 & 8	Old Burn/Small Arms Firing Range	Metals	
		soil matrix	78.3 - 157
		water matrix	79.0 - 141

[a]Pentaerythritol tetranitrate.
[b]Semi-volatile organic compounds.

Table 2-8. Summary of Percent Recoveries for Standard Matrix Spikes (1992 Phase I Data)

Chemical Class	Range (%R)
Cyanide	
soil matrix	---
water matrix	93.6 - 106
Anions	
soil matrix	77.8 - 117
water matrix	85.3 - 115
Metals	
soil matrix	0.0 - 137
water matrix	62.9 - 114
Explosives	
soil matrix	73.5 - 117
water matrix	57.2 - 120
Pesticides	75.0 - 106
soil matrix	62.5 - 149
water matrix	
SVOCs	
soil matrix	46.7 - 92.0
water matrix	48.0 - 120
VOCs	
soil matrix	91.7 - 123
water matrix	83.3 - 117

Percent recovery values outside of established method-specific ranges may indicate matrix interference effects. For instance, when more than 100 percent of an analyte is recovered, it is generally assumed that the sample matrix is contributing to the reported analyte concentration. Similarly, if percent recoveries are significantly less than 100 percent, the sample matrix may be influencing the analyte extraction process. RPDs also provide information regarding possible matrix interference effects during analyses. If RPDs are outside of statistically significant ranges, then variability in sample results can be attributed to variability in the matrix or the capability of a method to extract a particular analyte from that matrix.

2.4.4.2 *Field Quality Assurance/Quality Control*

Field QA/QC procedures, outlined in USAEC's QAP, consist of collection and analyses of field duplicates, equipment rinse blanks, and VOC trip blanks to provide information pertaining to the precision, accuracy, representativeness, and comparability of field data collected.

2.4.4.2.1 ***Field Duplicates.*** Field duplicate samples are two *separate* samples collected at the same location, consisting of the same matrix (soils), and analyzed for the same suite of analytes. Comparison of the results of field duplicates with collected sample results is indicative of the degree to which samples are homogeneous. A total of 32 field duplicates (31 soil duplicates and 1 duplicate collected from WW-1) were collected for the Phase II RI (1994 data). Eleven field duplicates were collected with the Fall 1995 soil samples. This is a frequency of approximately 1 duplicate per 20 samples. Duplicate samples were coded in the field using a unique site identification. Following analysis, duplicate samples were correlated with the analytical sample, and both samples were given the same site identification number with the duplicate sample flagged with a "D" flag code in the database. This was accomplished in order to provide "blind" duplicate samples to the laboratory. RPDs for the 1994 and 1995 data are presented in Sections 2.5.2.2.1 and 2.5.2.2.2.

2.4.4.2.2 ***Rinse Blanks.*** Rinse blanks are aqueous samples collected from the water used to rinse field sampling equipment after sampling and decontamination. A total of 41 equipment rinse blanks were collected during the 1994 Phase II RI field effort; 6 equipment rinses were collected in the 1995 field season. Results associated with these samples provide information on the effectiveness of field decontamination procedures, thus, providing critical information concerning potential cross-contamination between sampling locations. To determine cross-contamination potential, the analysis obtained for the rinse blanks are compared with the chemical composition of the water supply used to rinse the equipment. If a significant difference exists between the two, then cross-contamination between sampling locations could have occurred.

Analytical results for the 41 rinse blanks collected during the Phase II RI sampling program are shown in Table 2-9. These results indicate that the inorganics detected in the rinse blanks

Table 2-9. Analytes Detected in Equipment Rinses (1994 Data)

Analyte	SWMU 6	7	8	13	22	23	31	32	35	36	40
EXPLOSIVES											
1,3-Dinitrobenzene	1 (0.64)	3 (0.574-0.669)	NA[a]	NA	NA	NA	NA	NA	NA	NA	NA
1,3,5-Trinitrobenzene	NA	NA	NA	NA	1 (0.455)	NA	NA	NA	NA	NA	3 (0.289-5.54)
2,4,6-Trinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1 (0.576)
METALS											
Barium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1 (3.31)
Beryllium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1 (1.17)
Calcium	2 (128-132)	6 (110-146)	1 (156)	NA	1 (121)	1 (292)	1 (181)	NA	NA	NA	15 (115-285)
Iron	NA	NA	NA	1 (84.3)	NA	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	1 (19.4)	NA	NA	NA	NA	1 (19)	NA	1 (19)	6 (19.5-35.4)
PESTICIDES											
Delta-benzenehexachloride	NA	NA	NA	NA	NA	NA	NA	NA	1 (0.006)	NA	NA
Endosulfan Sulfate	NA	NA	NA	NA	NA	NA	NA	NA	2 (0.006-0.017)	NA	NA
VOCs[b]											
1,1,1-Trichloroethane	NA	NA	NA	NA	NA	NA	NA	1 (1.5)	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA	NA	NA	1 (3.7)	NA	NA	NA
Acetone	NA	NA	NA	NA	NA	NA	NA	1 (140)	NA	NA	NA
Bromodichloromethane	NA	NA	NA	NA	NA	NA	1 (0.91)	NA	NA	NA	NA
Chloroform	NA	NA	NA	2 (5.4-5.9)	NA	NA	1 (5.5)	2 (4.7-5.4)	NA	NA	NA

Notes.—All concentrations are $\mu g/L$ equivalent to ppb. The number of hits are shown, followed in parentheses by the range of concentration detected.
[a]Not applicable (no analytes detected).
[b]Volatile organic compounds.

are consistent with concentrations of inorganics in the water supply used during the field program taken from water well WW-3. Various explosives, metals, pesticides, and VOCs were present in detectable concentrations in the rinse blanks. The explosives 1,3-dinitrobenzene and 2,4,6-trinitrotoluene were detected in rinse blanks at concentrations less than 1 μg/L, while 1,3,5-trinitrobenzene was present at a concentration of 5.54 μg/L in a rinse blank associated with SWMU 40. Five metals (barium, beryllium, calcium, iron, and zinc) were also present at detectable concentrations. These metals are believed to be present as a result of the decontamination water used to rinse the sampling equipment provided from water supply well WW-3. Barium and beryllium were detected at concentrations of less than 5 μg/L, while iron and zinc were detected at concentrations well below 100 μg/L. The two pesticides delta-benzenehexachloride and endosulfan sulfate were detected at concentrations less than 1 μg/L (SWMU 35). Acetone represented the VOC detected at the highest concentration, 140 μg/L in a rinse blank associated with SWMU 32. The VOCs 1,1,1-trichloroethane and 1,1,2,2-tetrachloroethane were detected at concentrations less than 10 μg/L in the rinse blanks associated with SWMU 32, while bromodichloromethane was present at a concentration less than 1 μg/L in the rinse blank from SWMU 31. Chloroform was also detected at concentrations less than 10 μg/L in rinse blanks associated with SWMUs 13, 31, and 32.

Table 2-10 presents the summary of analytes detected in equipment rinses associated with the Fall 1995 field effort. Distilled water from a Salt Lake City supplier was used for the decontamination water for these rinses. Calcium and nitrite/nitrate may be due to the distilled water; however, field and laboratory contamination are also possible sources. OCDD and 678HPF are probably the result of low-level laboratory contamination which is frequently found in ultra-trace analytical determinations; however, potential contamination from sampling equipment cannot be eliminated as a possible source. The explosive 1,3,5-trinitrobenzene was detected once at SWMU 40; however, it was flagged "U" for unconfirmed, and is likely associated with equipment contamination.

A summary of the analytes and average concentrations detected in equipment rinses associated with the 1992 Phase I data are presented in Table 2-11. Low levels of some dioxins/furans, a few metals, several anions, and some VOCs typically associated with laboratory contamination were observed.

2.4.4.2.3 ***Trip Blanks.*** Trip blanks are aqueous samples transported with the actual samples from the field to the laboratory and are used to identify potential sample contamination during transport. Trip blanks are prepared by the laboratory and consist of a VOC vial filled with the distilled water in use at the lab. The vial is sealed at the lab. The blanks are placed in the sampling cooler at the beginning of each day that VOC samples will be collected and then accompany the samples to the lab. A total of 12 trip blanks were shipped and analyzed under the 1994 Phase II RI field sampling program. Trip blanks were analyzed for VOCs since contamination from the air is generally the only way field samples are contaminated during transport. Analytical results for the trip blanks are shown in Table 2-12. Only 5 VOCs (1,1,1-trichloroethane, 1,1,2,2-tetrachloroethane, acetone, chloroform, and methylene chloride) were detected in trip blanks associated with the 11 SWMUs. Methylene chloride was

Table 2-10. Summary of Analytes Detected in Equipment Rinses (1995 Data)

Sample ID	SWMU[a]	Analyte	Concentration	Flag Codes
3ER-66	6	678HPF[b]	2.56E-06	JP
3ER-67	8	Calcium	108.0	
3ER-68	6	678HPF	1.59E-06	JP
3ER-68	8	Calcium	141.0	
3ER-69	6	Calcium	245.0	
3ER-69	6	Octachlorodibenzodioxin	9.33E-06	JP
3ER-70	40	1,3,5-Trinitrobenzene	0.4	U
3ER-70	40	Nitrite, nitrate-nonspecific	98.7	

Note.—All concentrations in $\mu g/L$, which is equivalent to ppb.
[a]Solid waste management unit.
[b]678HPF - 1,2,3,4,6,7,8-Heptachlorodibenzofuran

Table 2-11. Summary of Analytes Detected in Equipment Rinses (1992 Phase I Data)

Analyte	Description	Chemical Class		Concentration	Data Qualifiers
OCDD	Octachlorodibenzodioxin	Dioxins/Furans		0.00036	B
OCDF	Octachlorodibenzofuran	Dioxins/Furans		0.00004	
TCDF	Tetrachlorodibenzofuran	Dioxins/Furans		0.00000	
THCDF	Total hexachlorodibenzofurans	Dioxins/Furans		0.00001	
THPCDD	Total heptachlorodibenzodioxins	Dioxins/Furans		0.00002	
THPCDD	Total heptachlorodibenzodioxins	Dioxins/Furans		0.00004	B
THPCDF	Total heptachlorodibenzofurans	Dioxins/Furans		0.00001	
TPCDF	Total pentachlorodibenzofurans	Dioxins/Furans		0.00000	
TTCDF	Total tetrachlorodibenzofurans	Dioxins/Furans		0.00000	
			Average	**0.00005**	
BA	Barium	Metals		110.0	
BA	Barium	Metals		1.8	
BA	Barium	Metals		91.0	
BA	Barium	Metals		30.1	
CU	Copper	Metals		7.4	
FE	Iron	Metals		28.9	
ZN	Zinc	Metals		23.8	
			Average	**41.8**	
BR	Bromide	Anions		198.	
CL	Chloride	Anions		250,000	X
NO3	Nitrate	Anions		3,900	
SO4	Sulfate	Anions		100,000	
			Average	**88,525**	
ACET	Acetone	VOCs		6.00	S
CH2CL2	Methylene chloride	VOCs		6.96	B
CH2CL2	Methylene chloride	VOCs		8.92	B
			Average	**7.29**	

Note.—All concentrations in $\mu g/L$, which is equivalent to ppb.

Table 2-12. Analytes Detected in Trip Blanks (1994 Data)

Analyte	SWMU[a] 13	31	32	35	40
VOCs[b]					
1,1,1-TRICHLOROETHANE	NA[c]	NA	1 (2.4)	1 (6.6)	NA
1,1,2,2-TETRACHLOROETHANE	1 (4.8)	NA	NA	NA	NA
ACETONE	NA	2 (35-42)	NA	1 (130)	NA
CHLOROFORM	3 (5.5-6.1)	NA	NA	NA	NA
METHYLENE CHLORIDE	NA	3 (3.6-4.1)	1 (4.0)	1 (3.7)	1 (4.5)

Notes.—All concentrations in μg/L, which is equivalent to ppb. Trip blanks analyzed exclusively for VOCs. VOC contaminants not present in detectable concentrations at SWMUs 6, 7, 8, 22, 23, and 36.

[a]Solid waste management unit.

[b]Volatile organic compounds.

[c]Not applicable (no analytes detected).

the most prevalent contaminant detected, present in trip blanks from SWMUs 31, 32, 35, and 40 at concentrations less than 5 μg/L. Chloroform, 1,1,1-trichloroethane, and 1,1,2,2-tetrachloroethane were detected in trip blanks at concentrations less than 10 μg/L. The VOC detected at the highest concentration was acetone, which was detected at a concentration of 130 μg/L in a trip blank associated with SWMU 35. Trip blanks associated with SWMUs 6, 7, 8, 22, 23, and 36 did not contain detectable concentrations of VOC contaminants. No trip blanks were collected during the 1995 field collection activities since VOCs were not included in the analytical suite. The only analyte detected in trip blanks collected during the 1992 Phase I field investigations was methylene chloride with concentrations ranging from 0.007 μg/L to 9.8 μg/L with an average value of 6.4 μg/L.

2.4.4.2.4 ***Field Blanks***. Field blanks are collected to determine if field conditions may have impacted the analytical results of the soil or groundwater samples collected during the Phase II RI field investigation. Collection of field blanks consists of pouring deionized water into the appropriate sample containers in the field. Field blanks were collected in association with sampling at one of the SWMUs in the OU. A total of three field blanks were collected during the 1994 Phase II sampling activities, one associated with each of the OUs. Analytical results of field blanks helped to determine if contamination may have been the result of airborne particulates in the atmosphere or of sampling procedures.

Various explosives, metals, pesticides, and VOCs were present in detectable concentrations in the three field blanks, as shown in Table 2-13. The only explosive detected was 1,3-dinitrobenzene, which was present solely in the field blank associated with OU 9 at a concentration of less than 2 μg/L. Only two metals, barium and calcium, were present at detectable concentrations. Barium was detected in the field blank associated with OU 4 at a concentration of less than 3 μg/L, while calcium was detected in each of the three field blanks at a maximum concentration of 340 μg/L. The pesticides alpha-benzenehexachloride, heptachlor, lindane, and DDT were detected at concentrations well below 1 μg/L. These pesticides were detected in field blanks collected at OUs 8 and 9. Three different VOCs were

detected, including chloroform, which was present in the field blanks from each OU at concentrations less than 10 $\mu g/L$. The compound bromodichloromethane was present in the field blanks collected from OUs 8 and 9 at concentrations equal to or less than 1 $\mu g/L$, while acetone was detected in field blanks from OUs 4 and 9 at a maximum concentration of 62 $\mu g/L$.

Only one field blank was collected during the Fall 1995 sampling effort. The analytes detected in that field blank are presented in Table 2-14. The calcium could possibly be due to the distilled water obtained from a Salt Lake City supplier which was used for the field blank. The low levels of 678HPD and OCDD are probably due to low-level laboratory contamination. No detects for field blanks were observed in the 1992 Phase I data.

Table 2-13. Summary of Analytes Detected in Field Blanks (1994 Data)

Analyte	Operable Unit		
	4	8	9
EXPLOSIVES			
1,3-Dinitrobenzene	ND[a]	ND	1.65
METALS			
Barium	2.86	ND	ND
Calcium	340	129	144
PESTICIDES			
alpha-Benzenehexachloride	ND	0.0048	0.00812
Heptachlor	ND	ND	0.0102
Lindane	ND	ND	0.00408
DDT	ND	ND	0.00359
VOCs[b]			
Acetone	62	ND	37
Bromodichloromethane	1	0.91	ND
Chloroform	6.3	5.1	5.8

Notes.—All concentrations in $\mu g/L$, equivalent to ppb.
[a]Analyte not detected.
[b]Volatile organic compounds.

Table 2-14. Summary of Analytes Detected in the Field Blank (1995 Data)

Site ID	Analyte	Concentration $\mu g/L$ (ppb)	Flag Codes
3FB-P	Calcium	142 $\mu g/L$	
3FB-P	6,7,8-HPD[a]	2.55E-06 $\mu g/L$	JP[b]
3FB-P	Octachlorodibenzodioxin	4.3E-06 $\mu g/L$	JP

[a]1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin.
[b]The value is below the method detection level but below the instrument detection level.

2.5 DATA QUALITY ASSESSMENT

This section presents an assessment of the field and laboratory data quality. In order to accurately evaluate the results of the assessment, it is important to first identify the data quality objectives (DQOs) established for the 11 SWMUs presented in this report. Table 2-15 presents a summary of the DQOs for these SWMUs.

All of the DQOs for each of the 11 SWMUs were met by collecting, analyzing, and interpreting the soil, sediment, and groundwater samples and by successfully conducting the surveys at SWMUs 7 and 40. Field and laboratory data completeness, accuracy, precision, and representativeness were also key to meeting the DQOs and are presented in the following sections (2.5.1 and 2.5.2). The only exceptions to meeting the DQOs are as follows:

- Potential VOC contamination at the Bomb and Shell Reconditioning Building (SWMU 23).
- Potential antimony and thallium contamination at SWMUs 7, 8, 31, 35, and 40.

These data gaps will be addressed as part of the FS process or as required if future land use changes from industrial to residential.

2.5.1 Field Data

2.5.1.1 *Field Audits and Surveillances*

During the field investigation phase of the Phase II RI, USEPA Region VIII conducted a field QA audit for soil sampling on July 26, 1994. In addition, informal audits of field activities against established procedures were conducted by UDEQ personnel. No significant observations or findings resulted from the audits and observation trips. There were, however, several suggestions made on the existing procedures and areas of improvement needed in implementing them. No USEPA audits were conducted during the Fall 1995 sampling effort.

In addition to regulatory assessment of the adequacy and quality of the field methods being used, Rust E&I also performed an internal field audit. Several findings and observations were made which reflected a need to update or modify several of the field procedures and pointed out several areas where refresher training was needed for field personnel. Following a thorough evaluation by the project manager and the QA coordinator, it was determined that the quality of the data was not significantly affected. The following findings and observations were recorded during the internal field audit for the Phase II RI:

- No backup copy of health and safety documentation was being made and sent to the home office on a weekly basis as internal procedures require. This had no impact on the quality of the Phase II RI data.

- A temperature blank was not included with each cooler. The laboratory measured the temperature of the air inside the cooler in lieu of the temperature blank. Therefore, this finding had no impact on the quality of the Phase II RI data.

Table 2-15. Summary of the Phase II Data Quality Objectives

SWMU	DATA TYPE	OBJECTIVE	DATA USE	ANALYTICAL LEVEL
Former Transformer Boxing Area (31)	Surface Soil Samples	Determine if contaminant releases to the surface soil have occurred.	Site Characterization Risk Assessment	Level III
PCB Spill Site (32)	Surface/Subsurface Soil Samples	Determine if contaminants remain in the soil following spill cleanup.	Site Characterization Risk Assessment	Level III
Wastewater Spreading Area (35)	Surface/Subsurface Soil/Sediment Samples	Determine if contaminant releases to soil or surface water have occurred.	Site Characterization Risk Assessment	Level III
	Groundwater Sample (WW-1)	Determine if migration to groundwater has occurred.	Site Characterization Risk Assessment	Level III
Old Burn Area (6)	Surface/ Subsurface Soil/Sediment Samples	Determine if contaminant releases to the soil have occurred at locations not evaluated during Phase I.	Site Characterization Risk Assessment	Level III
Chemical Range (7)	Geophysical Surveys	Locate UXO and former trenches.	Site Inspection Site Characterization	Level I
	Surface/Subsurface Soil Samples	Determine if contaminant releases to the soil have occurred.	Site Characterization Risk Assessment	Level III
Tire Disposal Area (13)	Surface/Subsurface Soil Samples	Determine if contaminant releases to the soil have occurred.	Site Characterization Risk Assessment	Level III
Bldg. 1303 Washout Pond (22)	Surface/Subsurface Soil Samples	Further define extent of contaminant releases to the soil.	Site Characterization Risk Assessment	Level III
Bomb and Shell Reconditioning Bldg. (23)	Surface/Subsurface Soil Samples	Determine if contaminant releases to the soil have occurred.	Site Characterization Risk Assessment	Level III
Old Burn Staging Area (36)	Surface/Subsurface Soil Samples	Determine if contaminant releases to the soil have occurred.	Site Characterization Risk Assessment	Level III
Small Arms Firing Range (8)	Surface/Subsurface Soil Samples	Further define extent of contaminant releases to the soil.	Site Characterization Risk Assessment	Level III
AED Test Range (40)	Walking Survey	Determine location of debris and UXO.	Site Inspection Risk Assessment	Level I
	Surface/Subsurface Soil Samples	Determine if contaminant releases to the soil have occurred at locations not evaluated during Phase I.	Site Characterization Risk Assessment	Level III

- One sample label did not include the sampler's identity. This finding had no impact on the quality of the Phase II RI data.

- Training records did not include all required documentation. This documentation was obtained and the files were completed prior to completion of the field effort. There was no impact on Phase II RI data as a result of this finding.

- A QA manual in the field had not been properly updated. The updated procedures were inserted and no impact resulted from this observation.
- Field project files had minor problems with documents being misfiled and signatures being missed on some field forms. These problems were corrected and no impact to data quality resulted from this observation.

2.5.1.2 *Field Calibration*

The quality of field measurements was ensured through the daily execution of instrument calibrations or performance checks. Field procedures specify that instruments that fail the calibration or checks are not to be used until the instrument could be repaired or replaced. During the Phase II RI field investigation, none of the instruments failed the calibrations or checks.

2.5.1.3 *Completeness and Accuracy*

Prior to the start of field activities, a field database was established with all of the proposed samples and corresponding analyses entered. This database was monitored continuously for proposed versus actual results. This resulted in early detection of missed samples or analyses. The CoC records were also compared against the field database for completeness and accuracy. From the CoC record review and database monitoring, it was determined that no samples were lost as a result of improper field handling or shipping. One sample for explosives analysis from the AED Test Range was lost due to breakage of the glassware at the laboratory. During the data gap sampling in November 1995, one sample for dioxins/furans analysis was lost due to glassware breakage. This sample was replaced, resulting in no lost data. No samples exceeded laboratory holding times before being analyzed. Samples for which data were rejected are discussed in Section 3.1.1 and in the description of the data evaluation for quantitative risk assessment for individual SWMUs. There is only one instance when all data for a given sample were rejected, affecting all the explosives results for Test Pits 22, 23, 24, and 25 at the AED Test Range (SWMU 40). This affected 12 samples out of a total of 180 samples collected at this SWMU, resulting in less than 7 percent of the explosives analyses being rejected. In most cases, only one chemical in an analytical suite was rejected. In November 1995, three additional test pits were excavated adjacent to the four locations with rejected data, and nine samples were collected to replace the previous results. Review of equipment rinse blank analytical results from all SWMUs indicated that no sample data were in question as a result of incomplete decontamination. Very low concentrations were detected in the rinse blanks, and all detections in actual field samples exceeded 10 times the amount detected in the corresponding blank. Field personnel strictly adhered to field decontamination procedures throughout the Phase II RFI field investigation. Additionally, procedures for rapid collection of samples for VOC analysis were followed with an average collection time of 45 seconds, thus, minimizing loss of volatiles. Overall, it appears that the goal of 90 percent for data completeness for field data was achieved. All field records were placed in the project records, which were locked when Rust E&I personnel were not present to prevent loss of any of the field records.

Accuracy of field data was evaluated primarily through the review of completed field records for completeness, accuracy, and legibility. The accuracy of data entry was also checked by comparing hard copy print-outs of the entered data with the original field data.

2.5.1.4 *Field QC Samples*

To ensure that sample collection, handling, and shipping procedures resulted in quality results, several types of quality control samples were collected throughout the Phase II RI. These included equipment rinse blanks, filtration blanks, trip blanks, and field duplicates. The results from these samples are presented in Appendix I and are discussed in more detail in Section 2.4.4.1. The results of the QC sampling indicate that the sample collection, handling, and shipping procedures used during the Phase II RI were adequate and were being followed by field personnel. However, data from equipment rinse blanks indicate that, although the procedures were being followed by field personnel, decontamination may not have been adequate in isolated and minor instances. However, due to the low concentrations detected in the rinse blanks, none of the sample data were required to be omitted from the data set. Minor contamination also appeared in isolated trip blanks, but the same contaminants were found in method blanks, indicating the detections in the trip blanks may be due to laboratory contamination. Results of field duplicates showed that the sampling methodologies used provided representative and comparable samples.

2.5.2 Laboratory Data

2.5.2.1 *Data Quality Assessment Methodology*

The quality of Phase II RI laboratory data was assessed primarily through external Data Quality Assessments (DQA) performed by EcoChem, Inc., on 21 lots of analytical data collected during the second phase of sampling and analysis at the 11 SWMUs (1994 data). In addition, 46 lots of analytical data associated with the Fall 1995 sample collection activities were submitted for external DQA by Ecochem, Inc. for either Tier I (USEPA Level III) or Tier II (USEPA Level IV/V) data evaluation. The goal of the DQA was to evaluate both lot-wide and sample-specific data quality using USAEC's PAM 11-41 program requirements and additional criteria developed by USEPA. The assessment was designed to complement and supplement the USAEC QA program and includes previous evaluations of the data performed by the Chemistry Branch of USAEC. The following guidance served as a basis for assessing data quality for the Phase II RI:

- *Quality Assurance Program* (USATHAMA 1990)
- *Data Qualifier Definitions for Data Users* (USEPA 1988b; from letter dated September 1988 from Carla Dempsey, Co-Chairperson of USEPA's Data Usability Workgroup)
- *National Functional Guidelines for Organic Data Review* (USEPA 1991a)
- *Guidance on Remedial Investigations Under CERCLA* (USEPA 1985a)
- *Guidance on Feasibility Studies Under CERCLA* (USEPA 1985b)

- *Guidance for Data Useability in Risk Assessment* (USEPA 1992a)
- *Quality Assurance Program Plan for USATHAMA Laboratory Analysis of Environmental Samples* (DataChem Laboratories 1991)
- *National Functional Guidelines for Inorganic Data Review* (USEPA 1994a)

In addition, internal data quality evaluation was performed on both the 1994 and 1995 data by Rust E&I by evaluating the PARCC parameters of precision, accuracy, representativeness, completeness, and comparability.

Data validation was performed by EcoChem Inc., according to CLP guidelines where appropriate. Subsequent to the 1994 DQA, Ecochem established a DQA approach which consisted of two tiers representing the extent of the evaluation process. Tier I, which is equivalent to USEPA Level III, consists of performing a group and record check of the transfer file and processing the electronic data through a "data quality screening tool" (DQST) developed specifically for the DQA process. A written summary for each Tier I evaluation was provided. Tier II included all steps in Tier I but also involved extensive review of the hardcopy data packages including CoC forms, calibrations, sample and standard preparation, and other QC performance parameters. The data validation process reviewed both the technical and evidentiary quality of the data. Data validation includes the comparison of laboratory summarized QC and instrument performance standard results to the required control limits.

For the Phase II RI data, the following QC elements were reviewed as appropriate to the specific analytical method:

- Analytical holding times
- Initial and continuing calibration checks
- Instrument performance, tuning, and interference check samples
- Laboratory blank contamination
- Precision (comparison of replicate sample, lab spike, and matrix spike results)
- Accuracy (surrogate and internal standard recoveries, blank spike recoveries, matrix spike recoveries, blank contamination)
- Compound identification and quantification
- Detection limits (compared to CRL)
- Presence and completeness of CoC documentation
- Completeness of laboratory documentation for sample receipt, sample preparation, sample analysis, and sample result reporting
- Overall documentation practices
- Field QC as evaluated using field duplicates, field equipment rinsates, and trip blanks

EcoChem developed several standard operating procedures (SOPs) specifically designed for validating data under USAEC QA requirements. These SOPs include detailed worksheets and supplemental computerized spreadsheets. Unlike the 1994 data, Ecochem provided three additional database fields to the 1995 data which included the CLP data qualifier, CLP data qualifier code, and a field for changes made to the electronic file.

2.5.2.2 *Data Quality Assessment Results*

Rust E&I selected 21 sample lots from the 11 SWMUs included in the initial 1994 Phase II RI for TEAD-N. The 46 lots selected for the 1995 data included SWMUs 6, 8, and 40 only. The large number of lots selected from SWMU 40 was due primarily to the unusual nature of the propellant suite, some methods of which were not certified or required method development. The total number of lots represented approximately 10 percent of the total lots obtained during Phase II sampling and analysis activities. The lots were selected to provide a cross section of each method used during Phase II. Table 2-16 presents the lots selected for the 1994 data DQA process, and Table 2-17 includes those lots submitted for DQA on the Fall 1995 data.

The analysis report packages obtained from DataChem contained all of the documentation necessary to review a complete lot of analytical data as defined in PAM 11-41. This includes the Data Package Document Inventory List in Appendix T of PAM 11-41. IRDMIS transfer

Table 2-16. Analytical Data Lots Selected for Data Quality Assessment (1994 Data)

Lot	No. Samples	Method	Description	Media	SWMU(s)[a]
ANRP	12	LM23	VOC[b]	Soil	13
ANHJ	21	LH17	Pesticides	Soil	35
ANWT	5	UH20	Pesticides	Water	35
ANLG	38	KY15	Cyanide	Soil	22
ANWH	38	B9	Arsenic	Soil	23, 36
ANGK	27	Y9	Mercury	Soil	8
ANKC	16	JD20	Selenium	Soil	6
ANVA	16	LH17	PCB[c]	Soil	23
ANRS	5	UW25	Explosives	Water	35
AMGX	17	LW23	Explosives	Soil	40
AMIE	20	LW23	Explosives	Soil	40
AMVC	18	LW23	Explosives	Soil	6, 40
ANDS	16	LW23	Explosives	Soil	6
ANFY	15	LW23	Explosives	Soil	6, 7
ANWJ	39	JS12	ICP[d] Metals	Soil	22, 23, 36
ANVM	32	JS12	ICP Metals	Soil	32
ANUC	34	JS12	ICP Metals	Soil	6, 7, 31
ANCV	37	JS12	ICP Metals	Soil	40
ANFR	17	LM25	SVOC[e]	Soil	31
ANUH	13	LM25	SVOC	Soil	32
ANQQ	12	LM25	SVOC	Soil	13

[a]Solid waste management units.
[b]Volatile organic compounds.
[c]Polychlorinated biphenyls.
[d]Inductively coupled plasma.
[e]Semi-volatile organic compounds.

Table 2-17. Analytical Data Lots Selected for Data Quality Assessment (1995 Data)

Lot	No. Samples *	Method	Description	Media	SWMU(s)[a]	Validation Level **
AWHS	12	SW-846 8290	Dioxins/furans	Soil	6	Tier 2
AWDA	2	SW-846 8290	Dioxins/furans	Water	6	Tier 1
AWKZ	18	SW-846 8290	Dioxins/furans	Soil	6	Tier 1
AWHJ	4	SW-846 8290	Dioxins/furans	Water	6	Tier 1
AVRO	24	LW23	Explosives	Soil	6 & 40	Tier 1
AWBP	10	JS12	ICP[b] Metals	Soil	6	Tier 2
AWBQ	10	B9	Arsenic by GFAA[c]	Soil	6	Tier 2
AWBR	10	JD20	Selenium by GFAA	Soil	6	Tier 2
AWBS	10	7841	Thallium by GFAA	Soil	6	Tier 2
AWBT	10	7041	Antimony by GFAA	Soil	6	Tier 2
AWBU	10	Y9	Mercury by CVAA[d]	Soil	6	Tier 2
AVZA	5	SS12	ICP Metals	Water	8	Tier 1
AVXW	31	JS12	ICP Metals	Soil	8	Tier 1
AVZB	5	AX8	Arsenic by GFAA	Water	8	Tier 1
AVXX	31	B9	Arsenic by GFAA	Soil	8	Tier 1
AVZG	5	7041	Antimony by GFAA	Water	8	Tier 1
AVYB	16	7041	Antimony by GFAA	Soil	8	Tier 1
AVYC	16	7041	Antimony by GFAA	Soil	8	Tier 1
AVZD	5	SD25	Selenium by GFAA	Water	8	Tier 1
AVXY	31	JD20	Selenium by GFAA	Soil	8	Tier 1
AVZF	5	7841	Thallium by GFAA	Water	8	Tier 1
AVXZ	16	7841	Thallium by GFAA	Soil	8	Tier 1
AVYA	16	7841	Thallium by GFAA	Soil	8	Tier 1
AVUQ	5	CC8	Mercury by CVAA	Water	8	Tier 1
AVYQ	31	Y9	Mercury by CVAA	Soil	8	Tier 1
AVSY	16	LM25	SVOC[e]	Soil	40	Tier 2
AVSI	2	UM25	SVOC	Water	40	Tier 1
AVNC	10	LW23	Explosives	Soil	40	Tier 2
AVNE	2	UW25	Explosives	Water	40	Tier 1
AVRB	4	UW25	Explosives	Water	6 & 40	Tier 1
AVVU	16	LF05	Nitrocellulose	Soil	40	Tier 2

Table 2-17. Analytical Data Lots Selected for Data Quality Assessment (1995 Data) (continued)

Lot	No. Samples *	Method	Description	Media	SWMU(s)[a]	Validation Level **
AVWX	2	UF05	Nitrocellulose	Water	40	Tier 1
AVRR	16	LW30	Nitroguanidine	Soil	40	Tier 2
AVVS	2	UW29	Nitroguanidine	Water	40	Tier 1
AVRQ	16	LW27	PETN[f]/NG[g]	Soil	40	Tier 2
AVRT	2	UW27	PETN/NG	Water	40	Tier 1
AVRP	16	SOP # OL-DC-EC	Ethyl Centralite	Soil	40	Tier 2
AVRS	2	SOP # OL-DC-EC	Ethyl Centralite	Water	40	Tier 1
AWBI	16	SOP # IC-DC-ClO4	Perchlorate	Soil	40	Tier 1
AWBH	2	SOL # IC-DC-Cl04	Perchlorate	Water	40	Tier 1
AVTB	16	KY15	Cyanide	Soil	40	Tier 1
AVSJ	2	TY23	Cyanide	Water	40	Tier 1
AVVA	16	KF17	Nitrate	Soil	40	Tier 1
AVSC	2	LL8	Nitrate	Water	40	Tier 1
AWAX	16	KT07	Sulfate	Soil	40	Tier 1
AWCR	2	TT09	Sulfate	Water	40	Tier 1

* - Includes QC samples. ** - Tier 1 equivalent to USEPA Level III data validation; Tier 2 equivalent to USEPA Level IV/V data validation.

[a]Solid waste management units.
[b]Inductively coupled plasma.
[c]Graphite furnace atomic absorption.
[d]Cold vapor atomic adsorption.
[e]Semi-volatile organic compounds.
[f]Pentaerythrtol tetranitrate.
[g]Nitroguanidine.

files, the results of group and record checks, DataChem's QA Status Report to the USAEC Chemistry Branch, and USAEC Chemistry Branch Control Chart Letters were also included in the DQA.

The results of the DQA are presented in individual Data Quality Assessment Reports, which are included in this report as Appendix J. The following provides the general format used for presenting the results of the DQA for each lot:

- Deliverables and documentation
- Chain-of-custody/sample identification
- Field quality control

- Technical assessment
  - –Sample holding time
  - –Instrument performance check (gas chromatography/mass spectroscopy (GC/MS) methods)
  - –Initial and daily calibration
  - –Blank analysis
  - –Surrogate recovery (organic methods)
  - –MS/MSD analysis
  - –Internal standards (organic methods)
  - –Compound identification
  - –Compound quantification and reporting limits
  - –System performance
  - –Overall assessment of the data

All of the lots were previously reviewed by the USAEC Chemistry Branch and found to be acceptable under the USAEC requirements. They had all been submitted and accepted by IRDMIS. From an overall standpoint, this independent third party validation by EcoChem confirmed the data flags and data qualifiers assigned by DataChem and the USAEC Chemistry Branch, respectively.

2.5.2.2.1 ***Data Accuracy***. Accuracy is a quantitative measure of how close a measured value lies to the "true" value. Accuracy is usually evaluated by adding (spiking) a known amount of an analyte or surrogate to a specific matrix and comparing the measured results to the known amount added. The result is a ratio which is then multiplied by 100 and expressed as percent recovery. Bias, a closely related concept, is a measure of how the measured value systematically varies from the true value. Bias is expressed as the relative percent error or the percent recovery minus 100.

Sampling accuracy is partially evaluated by analyzing field QC samples such as field blanks, trip blanks, and rinsates (equipment blanks). In these cases, the true concentration is assumed to be zero and any detected analytes indicate a positive bias due to contamination.

Laboratory accuracy is assessed through the use of sample spikes and QC samples. A sample or blank may be spiked with an organic or inorganic compound of known concentration, and the average percent recovery is calculated as a measurement of accuracy. A second method for determining accuracy is to analyze a standard (i.e., standard reference materials, certified reference materials, or continuing calibration standards) to calculate the percent difference between the measured value and the statistically determined value of the standard. For the Phase II RI, the following were used to assess accuracy:

- High and low concentration blank spikes
- Surrogate spikes for organic analyses
- Matrix spikes for organic, metals, and inorganic analyses
- Initial and continuing calibration check samples for organic, metal, and inorganic analyses
- Transcription errors between data and transfer files
- Field blanks
- Trip blanks for volatile organic analyses

Duplicate spiked laboratory control samples (LCS or standard matrix spikes) are required as part of the USAEC analytical program for all performance-demonstrated (certified) methods and provide ongoing (one set per lot) information on the accuracy of the laboratory's performance of a specific method in a standard matrix. The percent recovery results of these samples are compiled on control charts and submitted to USAEC Chemistry Branch for ongoing approval. Several of the control charts reviewed by EcoChem contained points that were out of control. However, it was determined that over time the control limits had become so narrow that they no longer represented reasonable data quality objectives. This was reflected by USAEC's acceptance of the data and the fact that the "out-of-control" events would have been acceptable in other QA programs such as USEPA's Functional Guidelines.

For 1994 lots analyzed for metals, spike recoveries were often low for antimony. Many of these recovery results were approved, with qualifying codes, by the USAEC Chemistry Branch. Other results were rejected. Rejected antimony data have an "R" data qualifier and are discussed under individual SWMUs.

Many 1995 thallium, selenium, and antimony results by graphite furnace atomic absorption (GFAA) were qualified as "UJ" (not detected) based upon LCS and/or MS/MSD performance.

Lots analyzed for explosives indicated some problems with accuracy because of low and high spike recovery percentages being out of control range. The analytes affected by these problems were 1,3,5-trinitrobenzene and 2,4,6-trinitrotoluene in soil samples. In addition, one complete lot of explosives data was rejected due to low recoveries. This affected all explosives analyses for test pits 22 through 25 at the AED Test Range. All other explosives data were found to be acceptable. The rejected data did not affect the overall quality of the results. No 1995 explosives data were qualified by Ecochem.

2.5.2.2.2 ***Precision***. Precision is a measure of the reproducibility of an analytical result under a given set of conditions. The overall precision of a set of measurements is controlled by both sampling and laboratory factors. Reproducibility is affected by sample collection procedures, matrix variations, the extraction procedure used, and the analytical method used. Limits of precision due to sampling factors are project specific and related to media, time of sampling, equipment, or field personnel. Laboratory factors include both project- and sample-specific effects (i.e., heterogenous materials) and laboratory-specific effects (i.e., poor volume measurement by the extraction chemist).

For the Phase II RI, precision was measured by evaluating the RPD between the laboratory control sample pairs, MS/MSD, and field sample and corresponding sample duplicate, field sample, and corresponding laboratory duplicate. The RPD between the response factors for initial and continuing calibration were also evaluated for GC/MS methods. Few analytes required qualification on the basis of evaluation of the RPDs. Overall precision was found to be within the acceptable range for both USAEC and USEPA guidelines.

Field Samples. The overall precision of the field soil sampling was evaluated by collecting

field duplicates. Thirty-one duplicate soil samples and one duplicate water sample were collected at OUs 4, 8, and 9 during the 1994 Phase II RI investigation. The sample and duplicate data available for evaluation included metals, pesticides/PCBs, and SVOCs. Eleven field duplicates were collected during the 1995 Phase II RI investigation at SWMUs 6, 8 and 40 only. The sample and duplicate data available for evaluation included metals, explosives, and dioxins/furans. The field sampling precision was evaluated by calculating the RPD between the primary and duplicate analyses. RPDs were calculated only if both the primary and duplicate analyses were valid detects (i.e., no LTs, NDs, or GTs). Detailed RPD tables for each SWMU are contained in Appendix I.

The RPD calculation is as follows:

$$\% \text{ RPD} = 100 \times 2 \times (\text{ABS}(V1-V2)/(V1+V2)) \qquad \text{(Equation 1)}$$

where

% RPD	=	relative percent difference, expressed as a percentage
ABS	=	absolute value
V1	=	value, primary sample
V2	=	value, duplicate sample

In general, the RPDs indicate that the field sampling precision was acceptable. The average RPDs for target analytes for each SWMU for various chemical classes are presented in Tables 2-18 and 2-19. No outlier tests were performed on the data sets. The average duplicate RPD for RDX for one soil sample collected at SWMU 40 (1995 data) is very high; however, this could well be the result of sample inhomogeneity. Only one duplicate sample was collected at this location. Average RPDs for the SVOC analyses (1994) data tend to be rather high; however, this method is very complex with many analytes, a number of which typically exhibit poor GC/MS response. One sample pair for dioxins/furans analysis had a high % RPD. This difference can be related to inhomogeneous distribution of dioxins in the soil. Since detected concentrations are so low, a very small absolute difference can cause a high % RPD The majority of the RPDs which were high for metals were associated with GFAA analyses, which frequently are more difficult in nature and subject to matrix interferences. No field duplicate sample data were available for evaluation from the Phase I 1992 field investigation.

Laboratory Samples. The overall precision of the laboratory analyses determined by evaluating the analysis of MS/MSD pairs was acceptable. Sixty-nine pairs of soil MS/MSDs and one pair of water MS/MSDs, which were associated with field samples collected at OUs 4, 8, and 9 during the Phase II RI investigation, were prepared by the laboratory and analyzed. The MS/MSD data available for evaluation included metals, explosives, pesticides/PCBs, VOCs, and SVOCs. Seven pairs of soil MS/MSDs and one equipment rinse were collected during the Phase II 1995 field investigation and analyzed for metals, dioxins/furans, explosives, cyanide, selected anions, and several propellant compounds. The laboratory analytical precision was evaluated by calculating the RPD between the MS and its duplicate

Table 2-18. Relative Percent Difference for Field Duplicates in Soil Samples Collected at OUs 4, 8, and 9 (1994 Phase II Data)

SWMU	Description	Chemical Class	RPD[a] Range (%)
6	Old Burn Area	Metals	0.2 - 45.5
7	Chemical Range	Metals SVOCs[b] (1 analyte)	0.7 - 61.6 ---
8	Small Arms Firing Range	Metals	0.0 - 44.6
13	Tire Disposal Area	Metals	1.5 - 66.2
22	Bldg. 1303 Washout Pond	Metals	3.7 - 101
23	Bomb and Shell Reconditioning Bldg.	Metals Pesticides/PCBs[c] SVOCs	0.0 - 67.8 19.4 - 44.5 22.2 - 97.7
31	Former Transformer Boxing Area	Metals SVOCs	0.5 - 15.2 0.0 - 74.8
35	Wastewater Spreading Area (soil)	Pesticides/PCBs	18.6 - 22.3
	Wastewater Spreading Area (water)	Metals	0.5 - 3.2
36	Old Burn Staging Area	Metals	0.0 - 89.9
40	AED Test Range	Metals	0.0 - 65.7

[a]Relative percent difference.
[b]Semi-volatile organic compounds.
[c]Polychlorinated biphenyls.

Table 2-19. Relative Percent Difference for Field Duplicates in Soil Samples Collected at SWMUs 6, 8, and 40 (1995 Phase II Data)

SWMU	Description	Chemical Class	RPD[a] Range (%)
6	Old Burn Area	Metals Dioxins/Furans	0.0 - 17.5 1.8 - 191
8	Small Arms Firing Range	Metals	0.0 - 72.4
40	AED Test Range	Explosives-Nitroguanidine one sample only Explosives-RDX one sample only	--- ---

[a]Relative percent difference.

analysis. RPDs were calculated only if both the MS/MSD analyses were valid detects (no LTs, NDs, or GTs). Detailed RPD tables for each SWMU are contained in Appendix I. The method for RPD calculation presented above is the same for MS/MSD pairs as for duplicate analyses, except that the difference is calculated between the MS and the MSD and not the primary sample.

In general, the RPDs indicate that the laboratory analytical precision was acceptable. As in the duplicate analyses, %RPD tends to be higher for SVOCs and some explosives in the 1994 data. This may be due to the larger number of samples collected and analyzed, and the longer duration of the field sampling investigation. No outlier tests were performed on the data sets. The average RPDs for target analytes for each SWMU for various chemical classes are presented in Tables 2-20 through 2-23.

2.5.2.2.3 ***Completeness***. Overall data completeness for the project was better than the 90 percent goal established prior to the start of the Phase II RI field investigation activities. Out of all the samples collected during Phase II, all analyses were lost for only one sample or less than 1 percent. No data were lost due to missed holding times. Data problems that were encountered are discussed below.

All explosive data were rejected from lot AMJY due to low recovery from both the low and high spikes, and antimony data from the ICP metals/soil analysis were rejected from lots ANCV and ANQY because the low spike recovery was too low. One explosive analysis sample was lost due to container breakage at the AED Test Range (AED Test Pit 55 collected at 5 feet).

The single lot of nitrocellulose from the 1995 sampling at SWMU 40 was rejected due to excessive blank contamination. The samples were reanalyzed with the understanding that the holding time had been exceeded. Upon suggestions made by EcoChem, Inc., and Rust E&I, the laboratory was instructed to add an additional water wash (for a total of 4 washes) to the analytical procedure in order to remove inorganically bound nitrate-nitrite from the soil and Baker Sand. Method blanks were prepared from Baker sand, and also the RMA soil according to the USAEC method. Nitrate-nitrite was detected in the method blank wash from the Baker sand at 10 ug/L. The reanalyzed data were similar to the first set of analyses in that the blank values exceeded the CRLs. Recoveries for the QC samples were acceptable; however, if blank correction was made for the QC samples, the recoveries were outside of the control limits. There were fewer detects in the reanalyzed data, but based upon discussions with Datachem Laboratories and Ecochem, Inc., the data should not be considered quantitative since there is a strong possiblity of false positives. The method is dependent on complete removal of all inorganic nitrate-nitrite prior to analyzing for the organic nitrogen in the nitrocellulose. The value obtained from the Baker Sand method blank more likely represents the limit of detection. The evaluation of both sets of nitrocellulose data was not completed at the time of this report and will be provided at a later date. The omission of nitrocellulose data from the risk assessment is not considered significant since there are no toxicity values available with which to calculate a hazard index.

Table 2-20. Relative Percent Difference for MS/MSDs in Soil Samples Collected at OUs 4, 8, and 9 (1994 Phase II Data)

			% RPD[a]
SWMU	**Description**	**Chemical Class**	**Range**
6	Old Burn Area	Explosives	0.0 - 5.4
		Metals	0.0 - 50.0
7	Chemical Range	Explosives	0.0 - 4.1
		Metals	0.0 - 23.1
		SVOCs[b]	0.0 - 46.2
8	Small Arms Firing Range	Metals	0.0 - 178
13	Tire Disposal Area	Metals	0.0 - 92.9
		SVOCs	0.0 - 66.7
		VOCs[c]	0.0 - 6.2
22	Bldg. 1303 Washout Pond	Cyanide	0.4 - 2.0
		Explosives	0.6 - 19.1
		Metals	0.0 - 45.4
23	Bomb and Shell Reconditioning Bldg.	Cyanide	2.1 - 5.6
		Metals	0.2 - 55.4
		Pesticides/PCBs[d]	6.0 - 12.7
		SVOCs	0.0 - 109
31	Former Transformer Boxing Area	Metals (1 analyte)	—
		SVOCs	0.0 - 46.8
		VOCs	1.9 - 8.0
32	PCB Spill Site	Pesticides/PCBs	2.2 - 16.7
		SVOCs	0.0 - 23.4
		VOCs	0.0 - 4.5
35	Wastewater Spreading Area (soil)	Pesticides/PCBs	0.9 - 29.7
	Wastewater Spreading Area (water)	Explosives	16.0 - 107
		Metals[e]	0.0 - 5.9
		Pesticides/PCBs	1.2 - 7.2
		SVOCs	0.0 - 6.1
		VOCs	0.0 - 3.5
36	Old Burn Staging Area	Metals	0.0 - 80.1
40	AED Test Range	Explosives	0.0 - 6.8
		Metals	0.0 - 68.4

[a]Relative percent difference.
[b]Semi-volatile organic compounds.
[c]Volatile organic compounds.
[d]Polychlorinated biphenyls.
[e]Includes filtered and unfiltered data.

Table 2-21. Relative Percent Difference for MS/MSDs in Soils Collected at SWMUs 6, 8, and 40 (1995 Phase II Data)

SWMU	Description	Chemical Class	RPD[a] Range (%)
6	Old Burn Area	Dioxins/Furans	0.0 - 19.6
		Metals (2 analytes only)	4.2 - 11.4
8	Small Arms Firing Range	Metals	0.5 - 33.9
40	AED Test Range	Anions (one MS/MSD[b] pair)	0.8 - 3.6
		Cyanide (one MS/MSD pair)	---
		Ethyl Centralite (one MS/MSD pair)	---
		Explosives (one MS/MSD pair)	4.2 - 152
		Nitrocellulose (one MS/MSD pair)	---
		Nitroguanidine (one MS/MSD pair)	---
		Nitroglycerine (one MS/MSD pair)	---
		PETN[c] (one MS/MSD pair)	---
All	Equipment rinse	Antimony (one MS/MSD pair)	---

[a]Relative percent difference.
[b]Matrix spike/matrix spike duplicate.
[c]Pentaerythritol tetranitrate.

Table 2-22. Relative Percent Difference for MS/MSDs in Soil Samples (1992 Phase I Data)

Analysis	RPD[a] Range (%)
Mercury by CVAA[b]	0.0 - 3.6
Lead, Silver by GFAA[c]	0.0 - 18.9
Metals by ICP[d]	0.0 - 47.1
Cyanide (3 values only)	3.7 - 10.4
SVOCs[e]	0.0 - 92.7
PCBs[f] (2 values only)	0.40, 0.40
Explosives	0.0 - 16.7
Anions	0.0 - 15.8
VOCs[g] (2 values only)	15.2, 12.5

[a]Relative percent difference.
[b]Cold vapor atomic absorption.
[c]Graphite furnace atomic adsorption.
[d]Inductively coupled plasma.
[e]Semi-volatile organic compounds.
[f]Polychlorinated biphenyls.
[g]Volatile organic compounds.

Table 2-23. Relative Percent Difference for MS/MSDs in Water Samples (1992 Phase I Data)

Analysis	% RPD[a] Range	Average
Mercury by CVAA[b]	1.3 -7.0	3.8
Lead, Silver by GFAA[c] (2 samples only)	4.7, 17.8	11.3
Metals by ICP[d]	0.0 - 58.1	9.0
Explosives	0.23 - 1.96	1.2
VOCs[e]	0 0 - 20.4	9.3
SVOCs[f]	0.0 - 40.0	10.6
Anions	0.0 - 12.8	2.1
Pesticides	1.8 - 9.5	5.7

[a]Relative percent difference.
[b]Cold vapor atomic absorption.
[c]Graphite furnace atomic absorption.
[d]Inductively coupled plasma.
[e]Volatile organic compounds.
[f]Semi-volatile organic compounds.

Ecochem rejected or qualified several data records for a number of uncertified analytes, including several PCBs, aniline, and other SVOCs in 1995 data. These records were associated with non-target analytes and were not associated with detects in any field samples.

In addition to evaluating analytical accuracy as discussed in 2.5.2.2.1, percent recoveries for MS/MSD pairs were calculated for the 1995 data. Except for the high recoveries associated with the SVOCs and the nitrocellulose methods, the average %Rs were acceptable. Table 2-24 presents the summary of %Rs for the various chemical classes for the 1995 data. Other than removing four negative values for iron and aluminum as interferences in the ICP analyses, no outliers were removed.

Table 2-24. Summary of Percent Recoveries for Spiked Analytes in MS/MSD Pairs (1995 Data)

SWMU	Description	Chemical Class	Range	Average
6	Old Burn Area	Total Dioxins	63.4 - 128.2	94.0
		Total Furans	69.2 - 139	99.5
		Metals (Sb and Tl)	76.2 - 96.8	88.6
8	Small Arms Firing Range	Metals	6.0 - 119	87.4 **
40	AED Test Range	Explosives	83.8 - 106	99.1
		Nitrocellulose	—	147
		Nitroglycerine	—	110
		Nitroguanidine	—	125
		Pentaerythritol tetranitrate (PETN)	—	105
		Ethyl Centralite	—	81.6
		Cyanide	—	99.8
		Anions	67.5 - 125	102
		SVOCs	85.1 - 196	145

** - removed 4 negative values due to ICP matrix interference for aluminum and iron.

Several dioxin/furan data records were qualified due to excessive method blank contamination (1995 data). Laboratory "B" qualifiers were placed on 137 of 748 sample records, 83 of which also received a "U" or "UJ" qualifier combination by EcoChem, Inc. These records were subsequently treated as "non-detects" using the USEPA's 5X rule for laboratory contaminants. There were no rejected dioxin/furan data; therefore, all of the data were considered complete and usable for risk assessment purposes.

2.5.2.2.4 ***Representativeness.*** Field duplicate results, field blank, and lab blank results indicate that the data results are representative of the samples collected for the 22 lots that were assessed by EcoChem. For the total database, there were isolated instances of contaminants being detected at low concentrations within rinse blanks, trip blanks, and lab blanks. Where this occurred, the corresponding sample data were compared against the blank results using the 5X and 10X rules for screening data for laboratory contaminants. The data that had corresponding blank contamination were flagged.

2.6 BACKGROUND SOIL CHARACTERISTICS

This section contains an analysis of background data for the soil media at TEAD-N. The data sources are described, and the methodologies for selecting the background values for metals and cyanide are summarized.

2.6.1 Background Sampling Program

Background soil samples were collected during two concurrent investigative programs from 10 locations across TEAD-N during 1992. A total of 20 soil samples, including 1 field duplicate, were collected from locations inferred to be free from contamination based on historical release information. The sampling locations are presented in Figure 2-1. Six background locations were sampled as part of the TEAD-N Phase I Suspected Releases RFI (MW 1993), and four background locations were sampled as part of the first phase of the RI for OUs 4 through 10 (Rust E&I 1994a).

During the Round 1 investigation of the Phase II Known Releases RFI for TEAD-N, Rust E&I selected an additional background sample location to replace the two samples collected at location BK-003. These samples were thought to have been collected in an area with surface contamination. The new location, BK-005, is also shown in Figure 2-1. Additional SWMU-specific background samples were collected in 1993 for the *TEAD-N Suspected Releases RFI.* Because these samples form SWMU-specific background sets for four suspected release SWMUs, they are not included in the data set for the TEAD-N overall background set.

At each location, except SB-BK-004 and SB-BK-006, two background soil samples were collected: one from the surface and one from either the 2- or 3-foot sample interval. At SB-BK-004, a background soil sample and a field duplicate were collected at the surface, and

one background soil sample was collected from the 3-foot interval. At SB-BK-006, one background soil sample was collected from a depth of 10 feet only. All background soil samples were analyzed for metals. In addition, some of the samples were analyzed for cyanide (13 samples and a duplicate), pH (13 samples), and anions (bromide, chloride, fluoride, phosphate, and sulfate—varied subsets).

During the November 1995 field investigation, four background locations were selected for the collection of surface samples for dioxins/furans analysis (Figure 2-2). A concern that surface burning activities at SWMU 6 may have caused contamination of surface soils with dioxins/furans resulted in the collection of surface soil samples throughout SWMU 6. Recent soil sampling results for dioxins/furans conducted in background areas for the Site-Wide Ecological Risk Assessment (Rust E&I 1995) suggest that detectable concentrations of dioxins in the TEAD region are anthropogenic or widespread low background levels and may not be related to specific SWMU activity. The four Phase II RI background locations were located some distance away from the burning areas of SWMU 6 away from the dominant downwind directions. These locations (Figure 2-2) were designated as BKS-95-06, BKS-95-07, BKS-95-08, and BKS-95-09.

2.6.1.1 *Statistical Evaluation of Background Data Set*

A database was set up consisting of all the records from the analysis of the background samples for metals and cyanide (Table 2-25). The data were inspected to determine if any of the data records had been qualified, rejected, or flagged, and to determine the impact on the data usability. Data with a "K" flag code were dropped from the data set. According to the *IRDMIS Data Dictionary*, a K-code indicates "reported results affected by interference or high background." Due to dilutions, records flagged with a K have reported method detection limits (MDLs) much greater than the USAEC CRLs and some have MDLs higher than the detected values for the particular analyte. Of the preliminary data, 32 records had to be dropped due to K flag codes and the resulting high MDLs—7 records for antimony, 7 for arsenic, 1 each for beryllium and cadmium, 8 for selenium, and 8 for thallium. The rest of the data was acceptable for inclusion in the data set. The duplicate pair for the one surface soil sample was averaged, and the average was used in the background data set. The statistical evaluation of the background data set is diagrammed in Figure 2-3.

Detections of metals and cyanide analytes were statistically evaluated to calculate an upper bound background concentration for each particular analyte. The threshold background concentration was estimated by modifying the tolerance interval calculation procedures outlined in USEPA guidance for statistical analysis of groundwater monitoring data (USEPA 1989b).

A modified tolerance interval statistical analysis was run on all analytes that met the following two criteria: (1) analyte values within the data set were detected at a frequency greater than or equal to 85 percent, and (2) the data set for a given analyte passed the Shapiro and Wilk Test (W Test) for normality. The W Test is a statistical method designed for use with small data

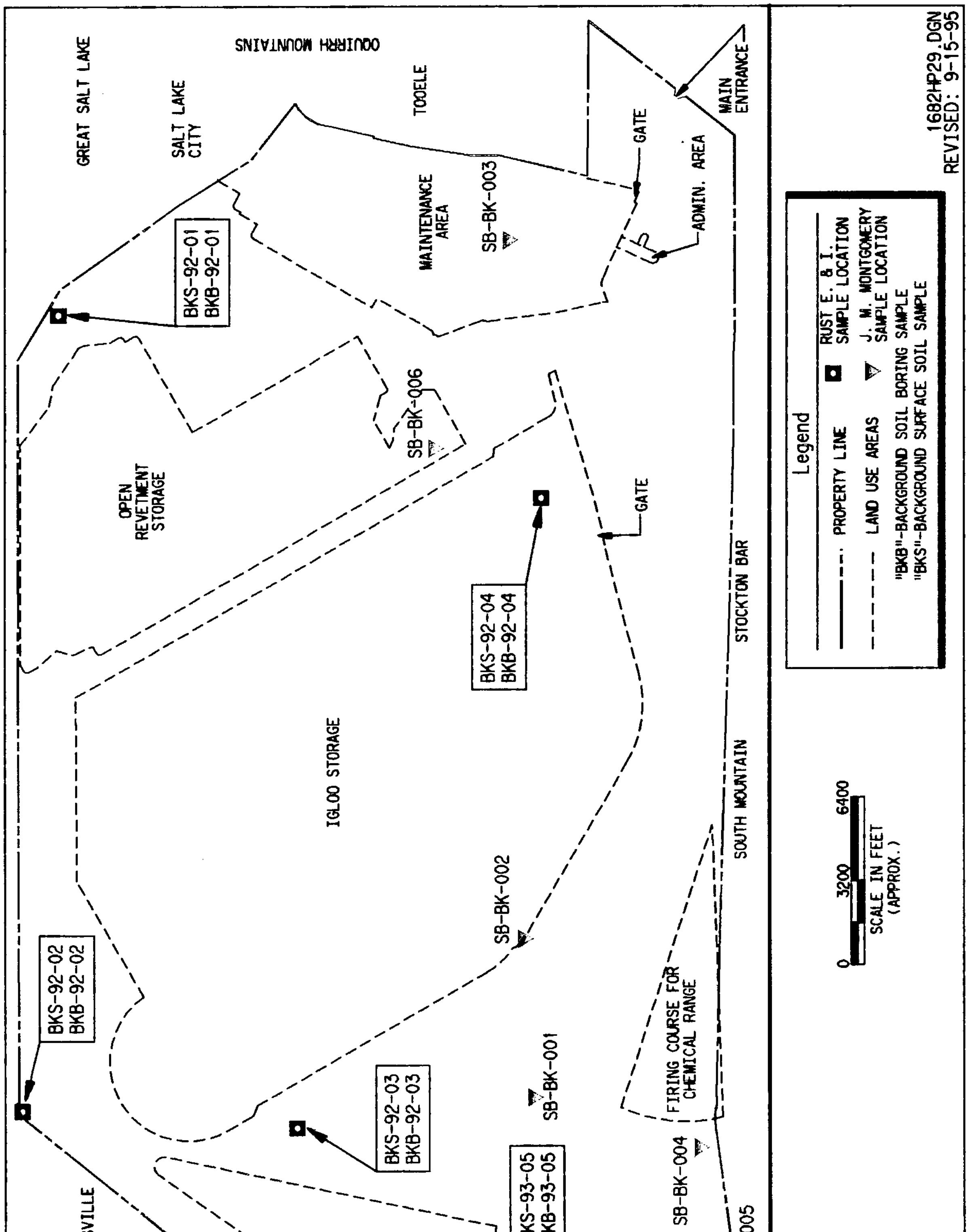


Figure 2-1. TEAD-N Background Soil Sample Locations

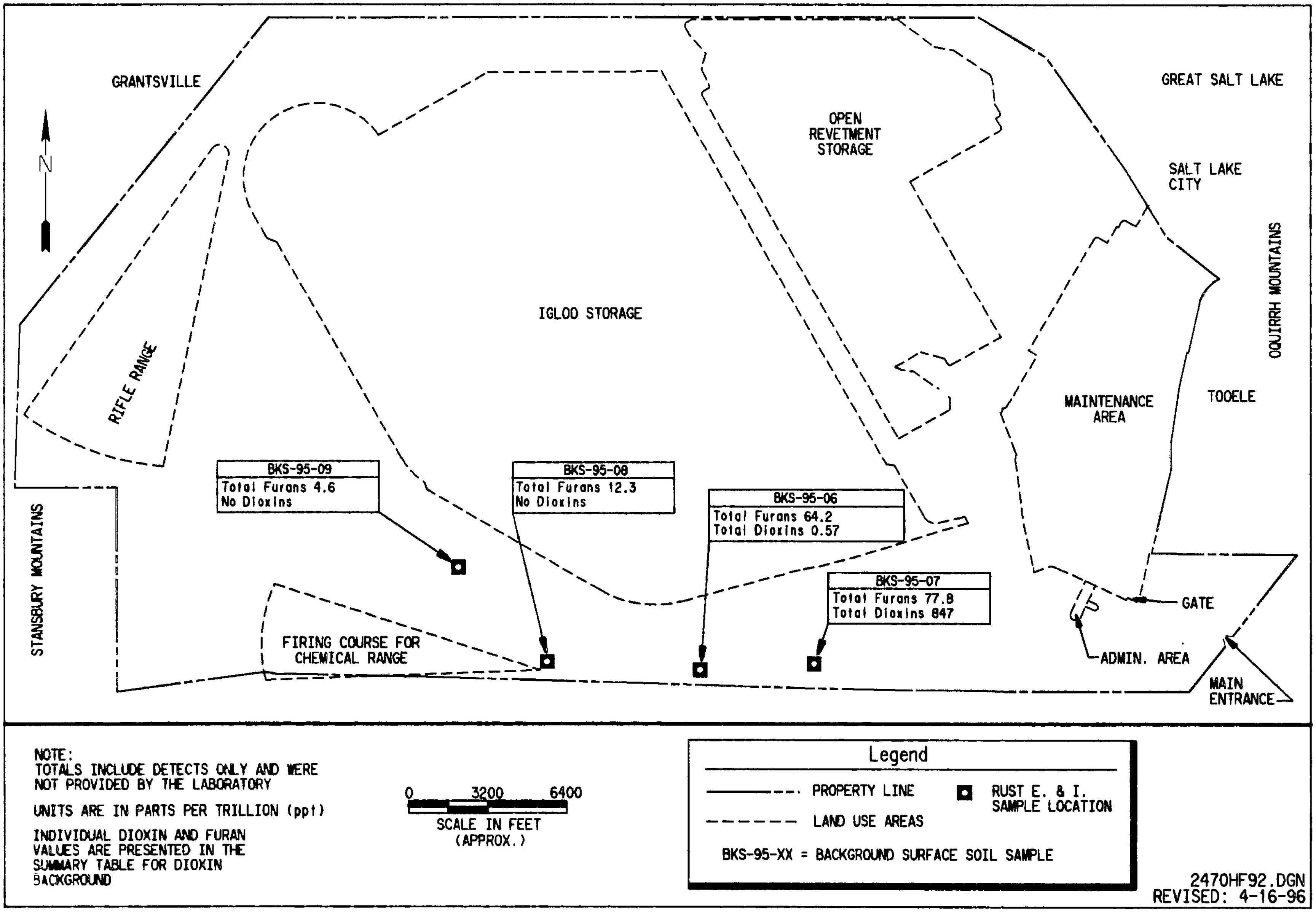


Figure 2-2. Background Sample Locations for Dioxins/Furans

Table 2-25. *Summary of Analytes Detected in the TEAD-N Soil Background Data Set*

Analytes	BKS-92-01 (0 ft)	BKB-92-01 (3 ft)	BKS-92-02 (0 ft)	BKB-92-02 (2 ft)	BKS-92-03 & (0 ft)	BKB-92-03 & (3 ft)	BKS-92-04 (0 ft)	BKB-92-04 (3 ft)	BKS-93-05 (0.5 ft)	BKB-93-05 (3.5 ft)
ALUMINUM	26000	32,000	22,000	11,000	5,500	2,700	19,000	9,900	8,630	4,380
ANTIMONY	LT 34 ¤	LT 34 ¤	LT 34 ¤	LT 34 ¤	LT 34 ¤	LT 3.42	LT 34 ¤	LT 34 ¤	LT 0.3	LT 0.3
ARSENIC	LT 120 ¤	LT 240 ¤	LT 120 ¤	LT 48 ¤	63	LT 240 ¤	LT 72 ¤	LT 240 ¤	5	LT 2.5
BARIUM	190	270	190	100	49	46	160	99	76	65
BERYLLIUM	LT 0.078	LT 0.23 ¤	LT 0.078	LT 0.078	LT 0.078	LT 0.078	LT 0.078	LT 0.078	LT 0.427	LT 0.427
CADMIUM	LT 0.424	LT 1.3 ¤	LT 0.424	LT 0.424	LT 0.424	LT 0.424	LT 0.424	LT 0.424	LT 1.2	LT 1.2
CALCIUM	32000	79,000	38,000	37,000	11,000	56,000	21,000	37,000	3,540	41,800
CHROMIUM	12.6	19	17	14	6	5	13	9	10	6
COBALT	LT 1.42	LT 1.42	LT 1.42	LT 1.42	LT 1.42	LT 1.42	LT 1.42	LT 1.42	4	4
COPPER	12.7	13	29	11	14	LT 1.95	12	6	12	6
CYANIDE	LT 5	LT 5	LT 5	LT 5	LT 5	LT 5	LT 5	LT 5	NT	NT
IRON	20000	26,000	17,000	11,000	7,500	3,400	16,000	11,000	12,000	10,000
LEAD	17	22	62	1	160	6	16	8	17	6
MAGNESIUM	15000	18,000	11,000	5,300	3,200	3,900	11,000	5,600	3,080	8,230
MANGANESE	610	600	660	270	270	59	520	220	234	171
MERCURY	0.0374	LT 0.0259	LT 0.0259	LT 0.0259	LT 0.0259	LT 0.0259	LT 0.0259	LT 0.0259	LT 0.05	0
NICKEL	LT 2.46	LT 7.5 ¤	LT 2.46	LT 2.46	LT 2.46	LT 2.46	LT 2.46	LT 2.46	8	9
POTASSIUM	7100 @	8200 @	6800 @	2800 @	1,300	600	5000 @	2400 @	2,210	913
SELENIUM	LT 5100 ¤	LT 5100 ¤	LT 510 ¤	LT 510 ¤	LT 510 ¤	LT 510 ¤	LT 510 ¤	LT 510 ¤	LT 0.449	LT 0.449
SILVER	0.212	0	0	0	1	0	0	0	LT 0.803	LT 0.803
SODIUM	NT	NT	NT	NT	NT	NT	NT	NT	100	209
THALLIUM	LT 83 ¤	LT 170 ¤	LT 83 ¤	LT 170 ¤	LT 170 ¤	LT 170 ¤	LT 170 ¤	LT 170 ¤	LT 34.3	LT 34.3
VANADIUM	14.8	28	17	14	7	LT 1.34	21	11	13	11
ZINC	85	70	84	40	210	LT 7.96	54	27	33	18

Table 2-25. *Summary of Analytes Detected in the TEAD-N Soil Background Data Set (continued)*

Analytes	SB-BK-001 (0 ft)	SB-BK-001 (3 ft)	SB-BK-002 (0 ft)	SB-BK-002 (2 ft)	SB-BK-003 (0 ft)	SB-BK-003 (2 ft)	SB-BK-004 (0 ft)	SB-BK-004(D) (0 ft)	SB-BK-004 (3 ft)	SB-BK-005 (0 ft)	SB-BK-005 (3 ft)	SB-BK-006 (10 ft)
ALUMINUM	9,510	2,280	8,910	2,590	13,200	12,100	17,100	15,700	10,900	6,550	4,460	3,310
ANTIMONY	LT 7.14	LT 7.14	LT 7.14	LT 7.14	LT 7.14	LT 7.14	LT 7.14	LT 7.14	LT 7.14	LT 7.14	LT 7.14	15
ARSENIC	4	3	6	6	24	19	7	7	7	19	16	7
BARIUM	93	37	86	39	188	157	169	166	147	92	65	45
BERYLLIUM	1	1	1	LT 0.5	1	1	2	1	1	1	1	LT 0.5
CADMIUM	LT 0.7	LT 0.7	1	LT 0.7	1	LT 0.7	LT 0.7	LT 0.7	LT 0.7	LT 0.7	LT 0.7	LT 0.7
CALCIUM	2,580	9,060	3,160	18,900	38,200	34,600	47,100	47,300	28,000	36,800	69,000	170,000
CHROMIUM	10	LT 4.05	12	7	16	14	20	19	15	10	10	8
COBALT	4	2	4	2	5	4	7	7	6	3	3	2
COPPER	9	3	18	7	23	16	15	15	11	10	5	6
CYANIDE	LT 0.92	LT 0.92	LT 0.92	LT 0.92	LT 0.92	NT	LT 0.92	NT	LT 0.92	LT 0.92	NT	NT
IRON	10,200	4,450	10,200	4,790	12,900	10,900	16,300	15,400	13,300	7,040	6,770	5,580
LEAD	9	4	33	6	56	33	12	15	11	31	11	6
MAGNESIUM	3,760	1,330	4,070	2,160	10,100	7,800	11,400	11,100	6,950	5,620	9,990	35,600
MANGANESE	273	85	232	85	458	370	477	456	376	195	140	449
MERCURY	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
NICKEL	10	4	9	5	13	11	18	17	14	7	8	12
POTASSIUM	2,720	541	3,070	781	4,570	3,830	5,670	5,200	2,320	2,300	1,620	801
SELENIUM	LT 0.25	LT 0.25	LT 0.25	LT 0.25	LT 0.25	LT 0.25	LT 0.25	LT 0.25	LT 0.25	LT 0.25	LT 0.25	LT 0.25
SILVER	LT 0.589	LT 0.589	1	LT 0.589	1	LT 0.589	LT 0.589	LT 0.589	LT 0.589	LT 0.589	LT 0.589	LT 0.589
SODIUM	225	193	243	189	343	323	463	498	1,790	272	683	830
THALLIUM	LT 6.62	LT 6.62	LT 6.62	LT 6.62	10	LT 6.62	LT 6.62	LT 6.62	LT 6.62	LT 6.62	LT 6.62	12
VANADIUM	15	8	16	9	21	19	28	26	24	13	23	16
ZINC	40	14	54	18	107	76	65	62	54	59	27	23

Note. — All values in $\mu g/g$ (equal to ppm).

LT = Analyte concentration is less than CRL , the CRL is posted next to the "LT".

¤ = 'K' Flagging Code, not included in estimation of background statistics.

@ = Method '99', not included in estimation of background statistics.

NT = Not Tested.

& = Samples BKS-92-03 and BKB-92-03 were thought to be collected in an area of surface contamination. These two samples were replaced with BKS-93-05 and BKB-93-05.

(D) = Duplicate analysis, values for the duplicate pair were averaged in estimating background statistics.

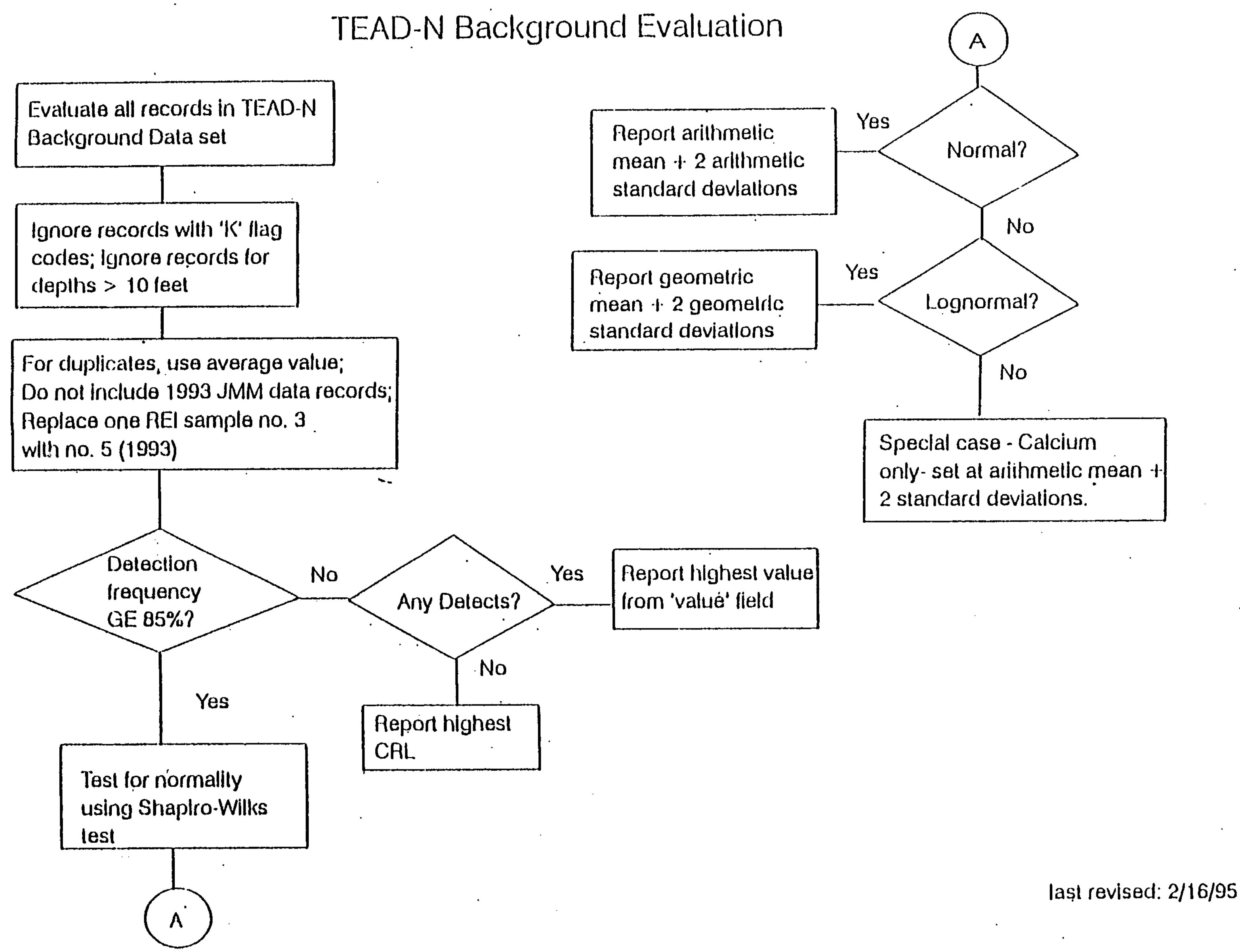


Figure 2-3. TEAD-N Background Evaluation Flow Diagram

populations and determines whether the values from a sample population are normally distributed. Any data point that was below the CRL or below the MDL (a non-detect) and was part of a data population that had a detection frequency greater than or equal to 85 percent was still used in the W Test and was assigned a value equal to one-half the CRL.

USEPA guidance (1989b) indicates that the use of a one-sided tolerance limit containing 95 percent of the population with a probability (confidence) of 0.95 is acceptable as the upper-bound background concentration. The calculation of the tolerance limit is the mean plus k-standard deviations. K is a parameter based on the sample size. A sample size of 65 results in a calculation of the upper-bound background concentration as: mean plus 2 standard deviations. Because the sample size for the TEAD-N background data set is much smaller than 65, strict application of the calculation would result in an even higher determination of background concentration (mean plus approximately 2.5 standard deviations). Thus, the use of mean plus 2 standard deviations is conservative. For three metals (chromium, manganese, and potassium), this approach resulted in a calculated threshold slightly higher than the maximum concentration detected in the sample population. These differences were evaluated and it was determined that use of the calculated threshold was appropriate.

If the sample population was determined to be normally distributed (i.e., the data passed the W Test), the threshold background concentration was set at the arithmetic mean plus 2 standard deviations. If the data failed the test for normality, the data were transformed by taking the natural log of each value and running a lognormal W Test. If the data met the criteria for lognormal distribution, the threshold background concentration was calculated as the geometric mean plus two times the geometric standard deviation.

Where the detection frequency was less than 85 percent and there were detectable concentrations, the highest detected concentration was used as the upper-bound background concentration and no statistical analysis was performed. If the specific analyte was not detected in any of the background samples within the data set, the highest CRL was used as the upper-bound background concentration.

Calcium had to be treated as a special case. There were greater than 85 percent detections, but the data were neither normally nor lognormally distributed. In this case, a mean and standard deviation was calculated, and the data were treated as if they were normally distributed. Table 2-25 provides a summary of analytes detected in the TEAD-N soil background data set.

Table 2-26 provides a summary of the background concentrations and threshold values of metals and cyanide detected in soils. The background threshold value represents a concentration below which detections can be assumed to belong to the naturally occurring distribution or the background population for the analyte. Investigative samples with concentrations above the background threshold value indicate the possibility of soil contamination.

The method used to calculate background threshold values results in numbers that are very conservative. This could result in identifying, as potential contamination, locations that are the

Table 2-26. TEAD-N Background Soil Sample Results and Threshold Values

Analyte	Detection Frequency, Detections/ Samples	Minimum ($\mu g/g$)	Maximum ($\mu g/g$)	Arithmetic or Geometric Mean ($\mu g/g$)	Arithmetic or Geometric Standard Deviation ($\mu g/g$)	Background Threshold Value ($\mu g/g$)	Distribution Type
Silver (Ag)	8/19	0.0421	0.66			0.66	< 85% Hits
Aluminum (Al)	19/19	2280	32000	11,743	8170	28,083	Normal
Arsenic (As)	12/13	2.5	24	7.1	2.3	11.7	Lognormal
Barium (Ba)	19/19	36.7	270	119	64	247	Normal
Beryllium (Be)	9/18	0.078	1.455			1.46	< 85% Hits
Calcium (Ca)	19/19	2580	170000	39,307	37,588	114,483	Special Case
Cadmium (Cd)	2/18	0.424	0.847			0.847	< 85% Hits
Cobalt (Co)	13/19	1.42	6.94			6.94	< 85% Hits
Chromium (Cr)	18/19	4.05	19.1	11.8	4.4	20.6	Normal
Copper (Cu)	19/19	3.36	29	11.8	6.5	24.7	Normal
Cyanide	0/14	0.92*	5			5	No Hits
Iron (Fe)	19/19	4450	26000	11,841	5,445	22,731	Normal
Mercury (Hg)	2/19	0.0259	0.0572			0.057	< 85% Hits
Potassium (K)	13/13	541	5435	2,393	1,528	5,449	Normal
Magnesium (Mg)	19/19	1330	35600	7,057	2.16	7,061	Lognormal
Manganese (Mn)	19/19	84.8	660	338	180	698	Normal
Sodium (Na)	13/13	100	1790	333	2.13	337	Lognormal
Nickel (Ni)	13/18	2.46	17.4			17.4	< 85% Hits
Lead (Pb)	19/19	0.786	62	12.67	2.78	18.2	Lognormal
Antimony (Sb)	1/13	0.3*	15			15	< 85% Hits
Selenium (Se)	0/13	0.25*	0.449			0.449	No Hits
Thallium (Tl)	2/13	6.62	11.7			11.7	< 85% Hits
Vanadium (V)	19/19	8.48	28	16.9	5.75	28.4	Normal
Zinc (Zn)	19/19	13.8	107	49.8	26.5	103	Normal

Note.—For cases where there were less than 85% hits, the statistical parameters were not calculated; rather, the highest hit was reported. For cases where there were no hits, the highest CRL was reported. Statistical parameters were not calculated for these cases.

*If no detections are listed, the range of DLs are provided. If only one detection was found, both the minimum and maximum values are listed. The range of DLs are also provided.

result of naturally occurring processes. Studies of natural background concentrations of metals in Utah (Dragun and Chiasson 1991) give distributions that are higher than the values calculated during the Phase II RFI for TEAD-N.

2.6.1.2 *Relationship of Background Concentrations to Soil Type*

As part of the *Phase II RCRA Facility Investigation Report, TEAD-N, Group A Suspected Releases SWMUs*, Montgomery-Watson prepared a discussion of the relation of the concentrations determined for background analytes to the various soil types found on TEAD-N (MW 1994). The conclusion was that coarse-grained soils across TEAD were not statistically different and could be combined as one population. The report also concluded that, based on small differences in the mean concentrations, the fine-grained soils should be treated as two populations, an eastern one and a western one. The differences were found in the mean concentrations for arsenic, barium, chromium, lead, thallium, and zinc with all but thallium being higher in the eastern fine-grained soils (medburn fine sandy loam). No statistical differences were found between surface and subsurface soils.

The analysis, based on very small sample numbers, indicates that there is not a significant difference in concentrations of analytes among the soil types identified at TEAD-N. Of the 11 SWMUs included in the Phase II investigation, only 1 SWMU contained the Medburn fine sandy loam (the Chemical Range, SWMU 7), where it is present on the eastern end of the firing course and at the firing point. Statistically, the small difference in the populations evaluated by JMM would have little impact on the SWMU-specific evaluations. Therefore, SWMU-specific background thresholds were not established.

2.7 GROUNDWATER CONTAMINATION POTENTIAL

2.7.1 General Site Conditions

The conventional method of determining the extent of contaminantion (i.e., if groundwater has been impacted) through sampling of monitoring wells is not an option at a number of the TEAD-N SWMUs. As shown in Figure 1-6, groundwater monitoring wells are limited to the eastern third of TEAD-N and a small area in the southern portion of the facility. As a result, of the 11 SWMUs that are the subject of this report, 10 do not have monitoring wells available for sampling purposes. Water Well 1 is located downgradient of SWMU 35. Installation of monitoring wells at these SWMUs is unnecessary because of the low potential for contaminant migration from the surface to the water table. There is low potential for groundwater contamination because of the thick vadose zone and the low annual precipitation on the valley floor, which is insufficient to promote contaminant migration from the ground surface down to the saturated zone.

The depth to groundwater ranges from approximately 100 to more than 700 feet bgs across the site. The shallowest groundwater was encountered in the eastern third of the facility. In the

southwestern corner of TEAD, an attempt was made to install a groundwater monitoring well. The hole was abandoned at a depth of approximately 700 feet bgs because no groundwater was encountered (ERTEC 1982).

Based on the groundwater contour map created using January 1993 groundwater elevation data (see Figure 1-7), the depth to groundwater was estimated for each individual SWMU. The approximate depth to groundwater for SWMUs 6, 7, 13, and 36 is 270 feet bgs. In the vicinity of SWMUs 31 and 32, the estimated depth to groundwater is 325 feet bgs, and at SWMUs 8, 35, and 40, the depth is approximately 350 feet bgs. Near SWMUs 22 and 23, the estimated depths to groundwater are 400 and 550 feet bgs, respectively. Assuming normal surface conditions, in conjunction with a vadose zone hundreds of feet thick that partially consists of fine-grained material, it is unlikely any contaminants deposited on the ground surface in solid form will reach the saturated zone.

Soil samples collected at depth and submitted for chemical analysis provide further evidence of the low potential for groundwater contamination. Previous work completed at SWMUs across TEAD included a number of 100-foot borings. Analytical results indicated metals and anions were present at depth; however, these analytes were considered naturally occurring. Trace concentrations of organic contaminants were detected (0.0229 μg/g of acetone and 0.0016 μg/g of toluene) in one soil sample collected at 35 feet bgs, which may have been the result of laboratory contamination since acetone and toluene were not detected in samples collected from 5 and 15 feet bgs from the same boring. As a general rule, organic contaminants did not migrate beyond 10 feet bgs based on data from the remaining 100-foot borings (MW 1993).

During the Phase II RI work, the majority of soil samples collected at approximately 10 feet bgs did not contain detectable concentrations of organics or metals in concentrations above associated background levels. However, soil collected at 10 feet bgs from SWMU 6 contained chromium and lead in above background concentrations. However, both lead and chromium concentrations generally decreased with depth, supporting vadose zone modeling results that indicate groundwater would not be impacted by metals from SWMU 6.

SWMU 7 soil samples contained several metals above their associated background concentrations. Mercury was present at a concentration of 2.1 times above background at 0.119 μg/g and was not detected in samples collected from the surface or 5 feet bgs in the same borehole. Thallium was detected at a concentration of 50.1 μg/g, or 4.3 times above the background concentration and increased with depth. Zinc was detected in subsurface soil at SWMU 7 at a maximum concentration of 12,000 μg/g at 5 feet bgs, decreasing to 2,500 μg/g at 10 feet bgs. Cadmium, chromium, copper, cobalt, nickel, vanadium, and arsenic were also detected at above background concentrations at 10 feet bgs. As with the metals at SWMU 6, vadose modeling for SWMU 7 indicate these concentrations of metals have not migrated to the groundwater.

Chromium was also detected in samples collected at depths between 10 and 13 feet bgs from SWMUs 22 and 32 in concentrations exceeding background. Soil collected at 10 feet bgs from SWMU 22 also contained vanadium at above background concentrations (up to 37.7 μg/g).

In addition to the metals, two SVOCs and one explosive were also detected in soil samples collected approximately 10 feet bgs. Benzyl alcohol was detected in samples collected from SWMU 7, while di-n-butyl phthalate was detected in soils collected from SWMU 32. At the reported concentrations (maximum concentrations for both SVOCs was less than 2 μg/g), these compounds are not expected to migrate through the entire thickness of the vadose zone and impact groundwater.

Only one explosive was detected in soils at a depth of 10 feet bgs: 2,4,6-trinitrotoluene at 15 μg/g. The presence of 2,4,6-trinitrotoluene is associated with a hot spot at SWMU 22, which has been recommended for removal. Similar to the previously discussed SVOCs, 2,4,6-trinitrotoluene is not expected to impact groundwater.

Modeling, simulating organic contaminant transport through the vadose zone at TEAD, was completed for each of the 11 SWMUs evaluated during the Phase II RI. Modeling procedures and results are included in Appendix K. Results of the Phase II RI modeling support the conclusion that contaminants from the 11 SWMUs have not impacted the groundwater at TEAD. SWMU-specific results of the vadose zone modeling are presented in Sections 4.0 through 6.0.

Groundwater samples collected at TEAD that contained organic contaminants were associated with SWMUs with different source conditions compared to the 11 SWMUs evaluated in this Phase II RI. Most importantly, the source of contamination was discharge of process waters to unlined ponds and lagoons. Water containing the contaminants was stored in these ponds and lagoons, with contaminated water added daily during the operating periods. As a result, the contaminants were already in an aqueous form and, more importantly, downward migration potential was provided by the head maintained on the lagoons.

At the 11 SWMUs involved with this investigation, the COPCs are primarily explosives and metals, the major sources of which are explosives testing and exploded ordnance. The contaminants are contained in surface and shallow subsurface soils where they adsorb to the soil particles. The low annual precipitation in conjunction with evapotranspiration in this semi-arid climate is not sufficient to promote significant downward migration of these contaminants. Taking this information in conjunction with the thickness and type of material comprising the vadose zone into consideration, there is a very low potential for contaminants migrating from the surface to the water table.

2.7.2 Vadose Zone—Groundwater Screening Approach

This section describes the screening approach used to estimate the COPC travel time to the water table and the COPC concentrations at a potential on-site and off-site hypothetical receptor. The methods used to estimate input parameters are discussed in detail in the following subsections. The results of SWMU-specific vadose-zone-to-groundwater modeling are presented in subsections of Sections 4.0, 5.0 and 6.0. These results were utilized to determine if the groundwater pathway is complete within a 100-year time period and, if complete, whether any risks to human health exist.

Three primary tools were utilized to screen for COPCs via the soil-vadose-zone-groundwater pathway. These tools include the infiltration-root zone FORTRAN model PRZM-2, the vadose and saturated flow and transport FORTRAN model MULTIMED, and a spreadsheet model, GWM-1, which uses the equations described in MULTIMED to assist in calculating critical input parameters. The screening approach focuses on estimating critical input parameters using PRZM-2 and the GWM-1 spreadsheet, and subsequently using MULTIMED to calculate the COPC concentration when it reaches the water table. The critical input parameters were estimated using ultra-conservative values. This resulted in a conservative screening tool, with modeled COPC concentrations likely to be higher than those occurring under actual conditions in the TEAD-N area. If the model estimates indicate that a COPC reaches the water table within 100 years, the model was expanded to estimate the maximum on-site COPC concentration and the maximum off-site concentration at a hypothetical receptor at the northern boundary of the TEAD-N property (Figure 2-4).

Six general assumptions were made to facilitate the screening process:

1. The PRZM-2 estimated recharge rate may be much larger than actual as discussed in the previous section, Modeling Software. The smaller the recharge rate, the longer the contaminant travel time and the more diluted the contaminants will be upon reaching the water table. The higher recharge simulated in the model results in faster predicted contaminant travel times and greater contaminant mass fluxes to the aquifer as compared to more realistic natural conditions.

2. The model assumes that contaminants will be subject to leaching over the complete vadose zone distance from the surface to the water table. In the actual subsurface, several processes are acting that may immobilize or retard part or all of the migrating contaminants. The processes include chemisorption (formation of a covalent bond between an adsorbed element and a mineral surface), solid state diffusion (irreversible penetration of an element into pore spaces of a mineral's structure), or chemical precipitation. These processes determine the "element loading capacity of the soil" (i.e., maximum concentration of an element that a soil can immobilize). This capacity allows the soil to contain contaminant concentrations which may often exceed background. At the 11 SWMUs evaluated in the Phase II RI, many of the modeled contaminants' concentrations are only slightly above background levels, indicating that they could be contained by the soil, thereby reducing the likelihood that the contaminants would migrate to the groundwater (Dragun 1988).

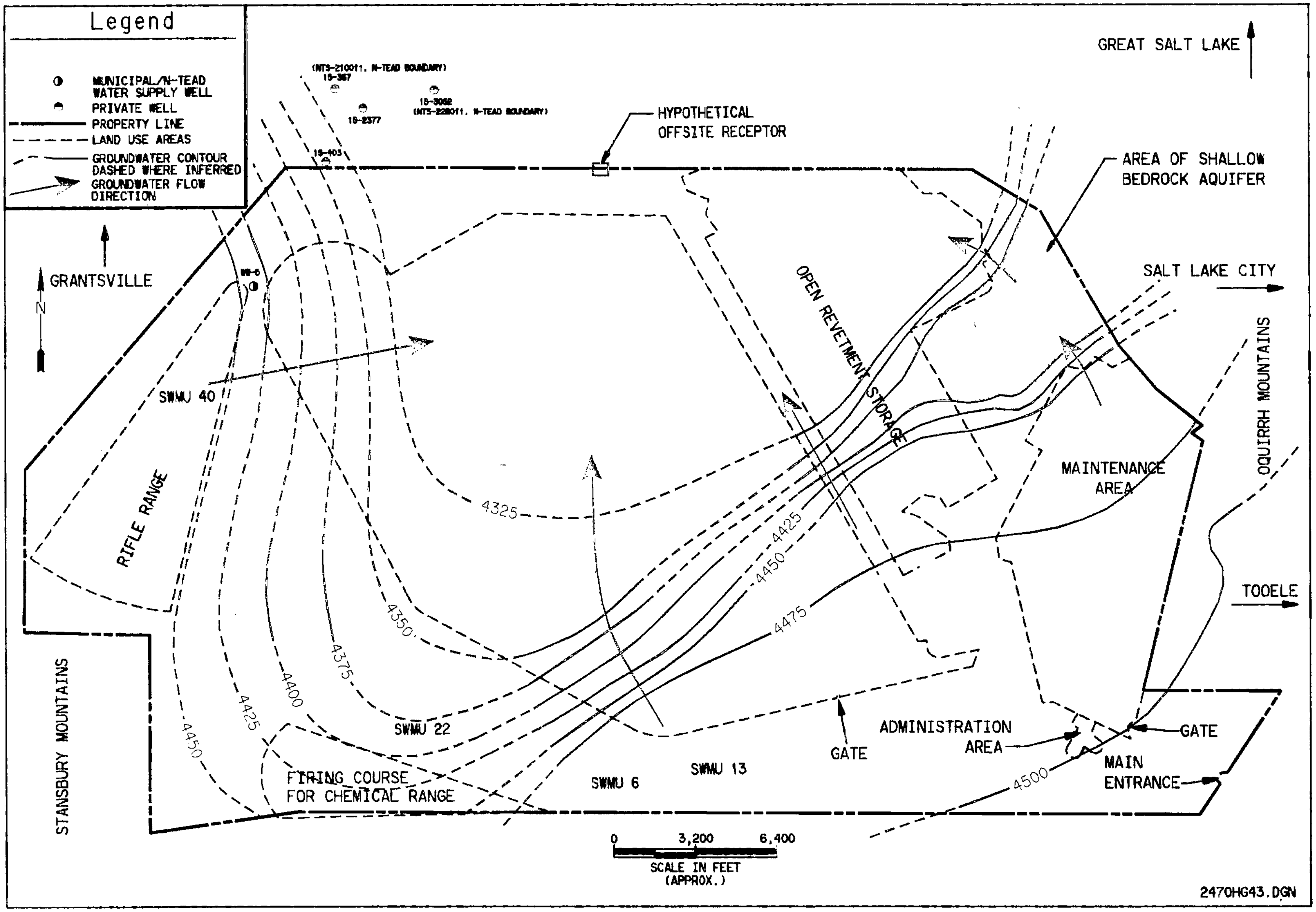


Figure 2-4. Location of Hypothetical Off-Site Receptor for Groundwater Pathway Modeling

3. Contaminant migration simulation using the model does not take into account lateral advective transport and dispersivity. These processes would cause a decrease in concentration through spreading and dilution. This phenomenon would be most pronounced if the vadose zone profile includes many soil layers with materials of different properties.

4. A wide range of measured values are presented in the literature for the distribution coefficients, K_d, and the normalized distribution coefficient, K_{oc}. The lowest quoted values were used in this modeling task. The higher the K_d or K_{oc} value, the larger the retardation factor R, and the slower the resulting movement of a contaminant. It is possible that actual K_d values are much larger than those used in the model for many contaminants. In such a case, contaminant travel time would be several orders of magnitude longer than that predicted by the model. The model, therefore, predicted movement of contaminants at higher rates than may actually occur.

5. Solubility limits on contaminant concentrations in water are not imposed as a condition on calculated soil water or simulated saturated zone concentrations. The resulting modeled concentrations, therefore, may be higher than those likely to occur in the subsurface environment. This is a conservative assumption. For example, metals are frequently listed in literature as insoluble under normal field conditions. However, solubility limits are not imposed in estimating initial pore-water concentrations.

6. All of the retardation input options to MULTIMED were set conservatively, resulting in very little effect taken into account for chemical degradation of COPCs due to volatilization, biodegradation, oxidation, or other concentration-reducing processes.

The following paragraphs discuss the conceptual model, the mathematical models, and the input parameters that are considered to be critical in maintaining a "conservative approach." A detailed description of the modeling process and Input/Output (I/O) files are contained in Appendix K. Finally, the model set up procedures are discussed with emphasis on the input parameter estimates.

2.7.2.1 *Conceptual Model*

As described above, a conservative approach was taken for contaminant migration simulations. This was accomplished by approximating input parameters with values that would most likely overestimate the actual value. As a result, the final concentration calculated from the modeling can be interpreted as representing a worse-case scenario, and the actual concentration (should contaminant migration from the surface to the shallowest aquifer actually occur) will be no higher than the concentration produced by the computer simulations. The methods used for estimating the input parameters are discussed below.

According to boring logs from groundwater monitoring wells previously installed at other TEAD-N locations, the subsurface deposits underlying the facility consist of interbedded alluvial and lacustrine gravels, sands, silts, and clays. For the purpose of simulating flow and

contaminant transport through the subsurface, the conceptual model used consisted of only one layer, assumed to consist of gravelly sand. As a result, at all of the 11 SWMUs modeled, the parameters associated with the soil properties in the vadose and aquifer zones—porosity, soil bulk density, saturated hydraulic conductivity, and organic carbon content—were assumed to be the same. Parameters associated with the site hydrogeology—aquifer thickness, mixing zone depth, vadose zone thickness, and hydraulic gradient—and the contaminant of interest —initial concentration, distribution coefficient, normalized distribution coefficient, and biodegradation coefficient—varied from SWMU to SWMU according to the field observations and the nature of the contaminant(s) being modeled. Figure 2-5 shows a schematic representation of the conceptual model.

This simplified subsurface model, consisting of only one vadose zone layer, adds to the conservative approach of the modeling. Using coarse-grained sediments for the entire thickness of the vadose zone allows for faster transport of the contaminant as it migrates through the vadose zone to the aquifer. When available, actual field data were incorporated into the conceptual model. In cases where such data were not available, parameters were conservatively estimated based on information contained in the *Multimedia Exposure Assessment Model (MULTIMED) Manual* (Sharp-Hansen 1990).

2.7.2.2 *Mathematical Models*

Two FORTRAN models and one spreadsheet model were used in simulating contaminant migration and estimating receptor point contaminant concentrations. These models include the *Multimedia Exposure Assessment Model* (MULTIMED), the *Pesticide Root Zone Model* (PRZM-2), and GWM-1.

2.7.2.2.1 ***MULTIMED.*** The MULTIMED model (Version 1.01; USEPA 1991) was selected as a basic tool for this modeling effort. MULTIMED was developed as a technical and quantitative management tool to address the problem of the land disposal of chemicals. It utilizes analytical and semi-analytical solution techniques to solve the mathematical equations that describe water flow and contaminant transport. Flow and transport within the vadose zone and saturated zone are simulated through the use of three modules. A one-dimensional module simulates flow in the vadose zone. The output from this module, water saturation as a function of depth, is used as input to the unsaturated zone transport module. This second module simulates one-dimensional (vertical) transport and includes the effects of longitudinal dispersion, linear adsorption, and first-order decay. Output from the unsaturated zone module is used to couple the vadose zone with the semi-analytical saturated zone transport module. The latter includes one-dimensional uniform flow, three-dimensional dispersion, linear adsorption, first-order decay, and dilution due to infiltration from the vadose zone to the groundwater plume (Salhotra et al. 1993).

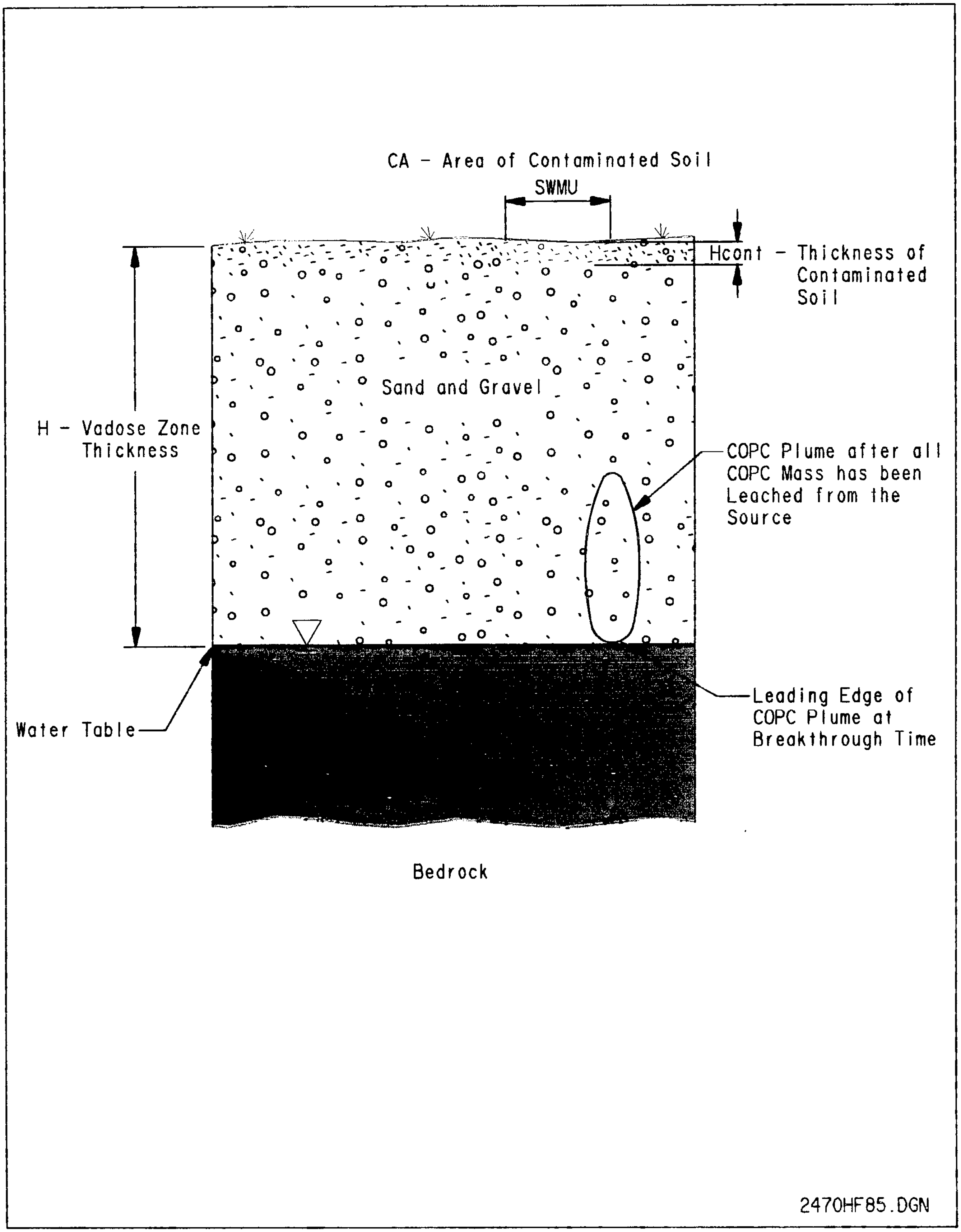


Figure 2-5. Schematic Representation of the Conceptual Model

2.7.2.2.2 *PRZM-2*. Two of the input variables for MULTIMED require user-specified rates for infiltration and recharge. Infiltration rate is defined to be the rate at which leachate percolates into the aquifer system from a land disposal facility. The recharge rate is defined to be the net amount of water that percolates directly into the aquifer system outside of the disposal facility. For the purpose of this model, it was assumed that infiltration and recharge rates were the same. The value for this parameter was estimated using the PRZM-2 model, as described below.

The PRZM-2 model (Release 2; USEPA 1993) is a one-dimensional, dynamic, compartmental model that can be used to simulate chemical movement in unsaturated soil systems within and immediately below the plant root zone. It has two major components: hydrology and chemical transport. Only the hydrology component of the model was utilized in this modeling task. The hydrology component for calculating runoff and erosion is based on the SCS curve number technique and Universal Soil Loss Equation. Evaporation is estimated either directly from pan evaporation data or based on an empirical formula. Evaporation is divided among evaporation from crop interception, evaporation from soil, and transpiration by the crop. Water movement is simulated by the use of generalized soil parameters, including field capacity, wilting point, and saturation water content (Mullins et al. 1993).

This model requires the use of meteorological data files, which are compiled by the National Oceanic and Atmospheric Administration and are available for all major meteorological stations in the U.S. Each file contains daily records of precipitation, Class A pan evaporation, temperature, wind speed, and solar radiation. A Salt Lake City file (W24127.MET) was used for PRZM-2 simulations in this project. The file contains data for years 1948 through 1983. A FORTRAN program PREC2.EXE was written for this modeling project to analyze the contents of the W24127.MET file. The analysis revealed 92.08 days with precipitation and 40.08 cm of precipitation per year on average over the analyzed period of 1948 to 1983 for the Salt Lake City station. No vegetation and low surface runoff values were used for PRZM-2 simulations in order to make the model predictions conservative. The result is a higher infiltration rate than the model would predict under less conservative assumptions (vegetation present, more surface runoff allowed). Model predictions for daily recharge were stored in a file TIMES.OUT. A FORTRAN program RECH2.EXE was written for this modeling effort to analyze the contents of the TIMES.OUT file. It was determined from the PRZM-2 output that there are 15.86 days with recharge below root zone, and 8.77 cm of infiltration per year on the average.

The PRZM-2 model does not take into account that over long periods of time without precipitation and recharge, hydraulic gradients in the vadose zone profile may be reversed and more water may be lost through evaporation (Scanlon 1994). Therefore, the average annual infiltration value predicted by the model (8.77 cm) may be considered very conservative. This higher infiltration value results in more potential for soil contaminants leaching to groundwater.

2.7.2.2.3 *GWM-1 Spreadsheet*

Prior to simulating contaminant migration using MULTIMED, the spreadsheet GWM-1 (Rzepecki 1994) was used to calculate pore water concentrations based on associated analytical soil data. This spreadsheet was developed specifically as a support tool for this modeling process. An example GWM-1 spreadsheet is presented as Figure 2-6.

The GWM-1 spreadsheet calculates several parameters necessary for the MULTIMED modeling to be completed. These parameters include the soil volumetric water content, contaminant travel time and velocity, pore water concentration, mixing zone depth, and source pulse duration.

Soil volumetric water content is calculated based on steady state recharge, soil saturated water content, and exponential parameter "b" according to the empirical equation presented in *Superfund Exposure Assessment Manual* (1988). This value is not directly used during the MULTIMED simulations, but is helpful in determining subsurface conditions.

The contaminant travel time from the ground surface to water table is calculated according to the following equation:

$$Tt = H / Vc \qquad \text{(Equation 1)}$$

where

Tt = contaminant travel time,
H = vadose zone thickness, and
Vc = contaminant travel velocity.

While contaminant travel velocity is computed using the following equation:

$$Vc = Vpw * R \qquad \text{(Equation 2)}$$

where

Vc = contaminant travel velocity,
Vpw = pore water velocity, and
R = retardation factor.

These two values initially determine the time period when the maximum contaminant concentration breakthrough occurs at the point of compliance. As a general rule, the contaminant travel time divided by 1.8 equals the approximate time of maximum contaminant concentration.

VADOSE ZONE / SATURATED ZONE FLOW & CONTAMINANT TRANSPORT EQUATIONS
SCREENING MODEL - "GWM-1.WK3" spreadsheet by Peter Rzepecki, RUST E & I, 1994.

Sources: MULTIMED Model, EPA, August 1990;
Superfund Exposure Assesment Manual - Vadose Zone Equations
EPA/540/1-88/001, OSWER Directive 9285.5-1, April 1988

Site Name	: Tooele North - SWMU 6
Analyte	: Antimony

Volumetric water content in the vadose zone calculation

q	=	2.40E-02	[cm/day] (recharge)
Ks	=	864	[cm/day] (saturated K)
b	=	4.05	[-] (exponential parameter, page 71)
VWC sat.	=	0.43	[-] (volumetric water content - satur. cond.)
1/(2*b+3)	=	0.0901	
VWC	=	0.17	[-] (volumetric water content)

Interstitial ground water (pore water) velocity calculation

Vpw	=	0.14	[cm/day]
H	=	8200	[cm] (vadose zone thickness)
Tt	=	156	[years] (pore water travel time)

Contaminant velocity calculation

Kd	=	45	[ml/g] (distribution coeff. - soil/water)
Bd	=	1.51	[g/cm^3] (soil bulk density)
R v	=	407.6	[-] (retardation coefficient)
Vc	=	3.53E-04	[cm/day] (contaminant travel velocity)
CTt	=	63690	[years] (contaminant travel time)

GW contaminant load calculation

CA	=	126300.0	[m^2] (contaminated area of the land)
C init	=	1.49E+00	[ppm] (pore water contam. conc. at source boundary)
C t1/2	=	0	[days] (cont. half life t, if not degrad. set to 0)
k	=	#DIV/0!	[1/day]
C at GW	=	1.49E+00	[ppm] (pore water contam. conc. at WT)
AL	=	1.7E+01	[kg] (annual contaminant load entering GW)

GW contaminant concentration estimate

K aq	=	864	[cm/day] (aquifer hydraulic conductivity)
Por aq	=	0.43	[-] (aquifer effective porosity)
Grad aq	=	0.0016	[-] (avg hydraulic gradient)
Dv	=	.199	[cm] (vertical dispersivity)
H aq	=	1000	[cm] (aquifer thickness)
M t. d.	=	4222	[cm] (theoretical mixing depth at s. d. g.)
M depth	=	1000	[cm] (mixing depth at source downgrad. edge) (MULTIMED equation)
D factor	=	1.62	[-] (dilution factor - vadose zone/aquifer)
C aq edg	=	9.22E-01	[ppm] (gw contam. conc. at source downgr. edge) (assuming no lateral dispersivity)
H cont.	=	365	[cm] (thickness of contamin. soil zone)
P. d.	=	2835	[years] (pulse duration - for MULTIMED simulation)

Pore water concentration calculation based on soil total conc.

Tc	=	6.06E+01	[ppm] (total soil concentration)
Slb	=	1.50E+00	[ppm] (chemical solubility)
Pwc	=	1.49E+00	[ppm] (pore water concentration) (assuming water density = 1 g/cc)

Contaminant travel time in aquifer calculation

R Kd	=	45	[ml/g] (aquifer distrib. coeff.)
R Grad aq	=	0.0095	[-] (avg regional hydraulic gradient)
D osr	=	6500	[m] (distance to "Off Site Receptor")
Bd a	=	1.51	[g/cm^3] (aquifer mat. bulk density)
R a	=	159.0	[-] (retardation coefficient)
T	=	14836	[years] (contam. travel time)

Figure 2-6. Example of GWM-1 Spreadsheet

The pore water concentration is calculated based on total soil concentration according to the following equation:

$$Pwc = [Tc * (Bd + VWC)] / [VWC + (K_d * Bd)] \qquad \text{(Equation 3)}$$

where

Pwc	=	pore water concentration,
Tc	=	total soil concentration,
Bd	=	soil bulk density,
VWC	=	soil volumetric water content, and
K_d	=	distribution coefficient.

It was assumed that the total soil concentration as reported by the laboratory represents concentration adsorbed in soil plus the concentration in water, and does not take into account the contaminant that may be fixed as part of the structure of soil minerals. This volume of contaminant represents the portion of chemical that is available to partition to water. The pore water concentration is input into the MULTIMED model as the source concentration.

As shown in the example spreadsheet, the pore water concentration is calculated off to the right of the main spreadsheet. The most important component of the above equation is K_d, the distribution coefficient (especially for metal contaminants). K_d dictates the amount of contaminant available to the subsurface based on the contaminants' chemical properties. The literature provides a wide range of K_d values, and in each case the lowest value in the range was used for modeling purposes to calculate the most conservative estimate. The spreadsheet is set up for the user to initially input the total soil concentration, which automatically determines the chemical solubility based on the K_d value. Subsequently, this value is adjusted until the pore water concentration is less than the chemical solubility. Once this adjustment is complete, the pore water concentration becomes the C_{init}, the pore water contaminant concentration at the source boundary. In the cases where the Kd is less than 1.0, a value of 1.0 is used. This prevents estimating a pore water concentration (mg/L) that is higher than the maximum soil concentration (ppm).

The mixing zone depth is calculated using the equation provided by Sharp-Hansen (1990). In the spreadsheet, the aquifer depth to which contaminants infiltrating from the source will be mixed with the aquifer water at the center of the downgradient edge of the source is calculated. This value is then directly used for the MULTIMED simulation to significantly decrease the computation time. Aquifer thickness is set to be slightly less (on the order of 0.1 meters) than mixing zone depth. Otherwise, the computation time would increase from 15 seconds to approximately 15 minutes per simulation. Both procedures were tested on numerous simulations, and produced the same results. For the saturated zone simulations to on-site and off-site receptors the aquifer thickness and mixing zone depth were both set to 50 meters to better represent the actual field conditions and to facilitate dispersion effects.

Finally, the source pulse duration is calculated by dividing the contaminated soil zone depth by the contaminant travel velocity. As a general rule, the contaminant travel velocity as calculated by GWM-1, is less than that calculated by MULTIMED. This is the result of the equation (which is provided by the Superfund Exposure Assessment documentation) used to calculate volumetric water content in GWM-1. This equation is very approximate and less rigorous than the procedure provided by Sharp-Hansen (1990). As a result, the pulse duration as computed by GWM-1 represents a conservative value, with the contaminant source acting longer than it would if the calculation was based on contaminant travel velocity as computed by MULTIMED.

2.7.2.3 ***Description of Modeling Steps.*** The procedure used during this modeling effort is represented by the flow chart presented as Figure 2-7. All modeling was based on the analytical data associated with soil samples collected at each SWMU. The following section describes the manner in which these data were screened, the procedure used to determine the area affected by the contaminants, and the thickness of the contaminated soil.

This information was used as input for the spreadsheet GWM-1 to compute the pore water concentration, travel time, and pulse duration in the vadose zone at each SWMU for each potential contaminant of concern. Water recharge to the vadose zone was estimated using PRZM-2 as described above. Results from both the GWM-1 spreadsheet and PRZM-2 were used as input into MULTIMED, which estimated the potential contaminant concentration in the groundwater should migration from the surface to the underlying aquifer actually occur and the length of time required for this migration to occur.

2.7.2.3.1 ***Selection of COPCs.*** For each of the SWMUs, analytical soil data were compared to background concentrations for each of the detected analytes. Soil samples were collected at various depths at each SWMU from surface samples, borings, and test pits. This allowed the thickness of the contaminated zone and the area affected by the contaminants to be determined individually for each SWMU. The thickness of the contaminated zone was calculated from the analytical data using an average depth at which contaminants were detected. For the 11 SWMUs modeled, this value ranged from 0.3 (SWMU 35) to 3.6 meters (SWMU 6). In order to calculate the affected area, a site map for each SWMU was used to determine the contaminant distribution. Generally, the entire contaminated area was used as input into the model for the source area.

In some instances, the SWMU was broken up into sub-areas for modeling purposes. SWMU 7 was divided up into three distinct areas of contamination (the firing point, trench, and chemical range areas) for modeling purposes. This was necessary because the contaminants detected were limited to these three areas. At SWMU 8, the source area was limited to the bullet stops and the firing lines. For the remaining SWMUs, the assigned source area was limited to the portion of the SWMU that contained soil sampling locations.

The maximum observed soil concentration, thickness of contamination, and source area were used for input into the GWM-1 spreadsheet. For the on-site receptor and off-site receptor

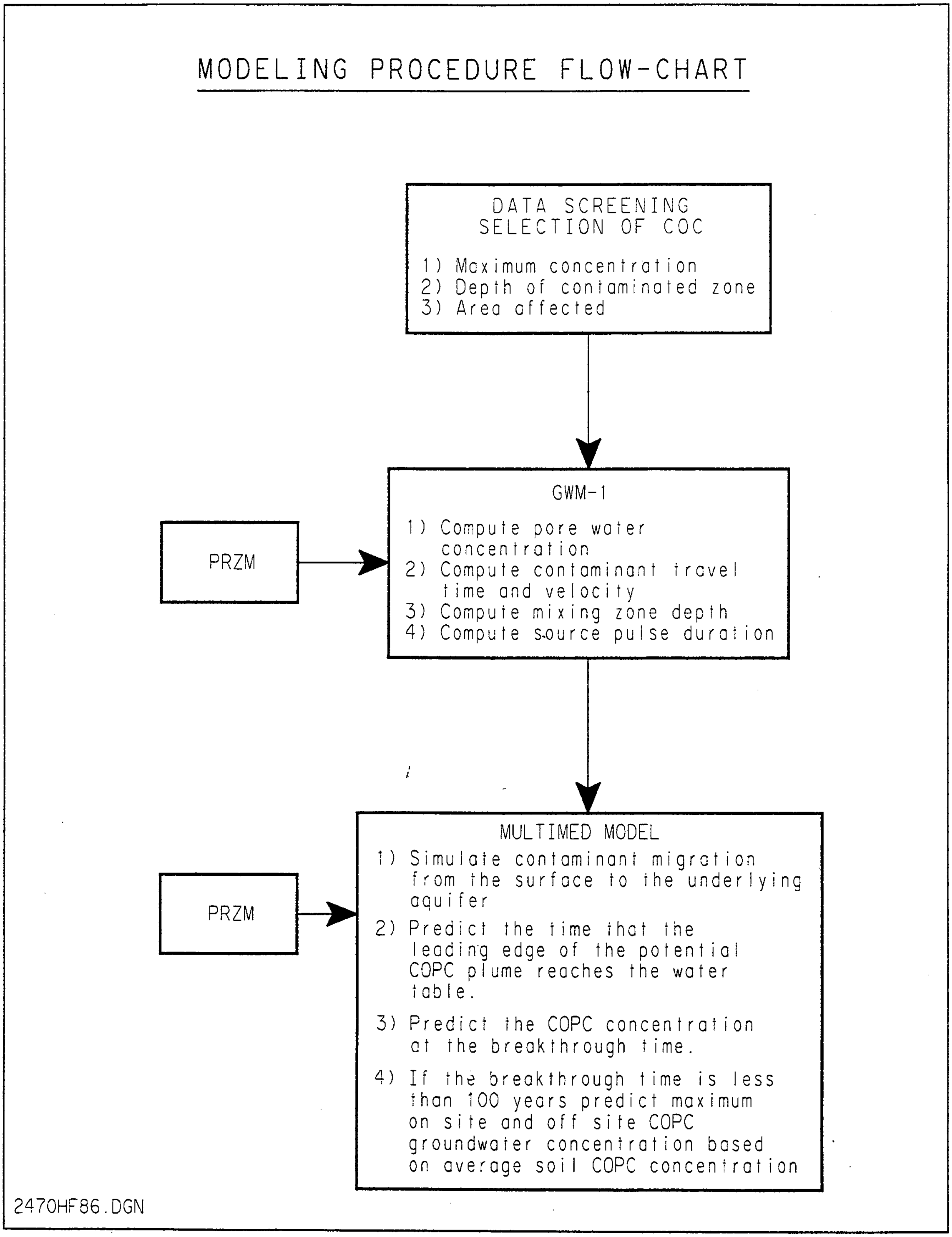


Figure 2-7. Groundwater Modeling Flow Chart

maximum groundwater COPC concentration estimates the average observed COPC soil concentration was used as initial GWM-1 input. The spreadsheet was used to calculate the pore water concentration along with pulse duration, mixing zone depth, and contaminant travel time and velocity. These values were then used for input into MULTIMED, which ultimately determined the contaminant concentration after migrating from the surface to groundwater and the length of time required for this migration to occur. Once the potential concentration was calculated, it was compared to the respective MCL or action level concentration where available. This concentration was also utilized in the human health risk assessment as an exposure point concentration for groundwater pathways under future use scenarios, such as ingestion.

2.7.2.3.2 ***Model Set-Up and Simulations.*** The list of MULTIMED input parameters for all simulations are included in the "MULTIMED Input Parameters" section of Appendix K. The following parameters were specific for each simulation or for a series of simulations:

- Vadose Zone Only
  - –Thickness of the unsaturated zone (values ranged from 82 to 168 meters)
  - –Biological decay coefficient (set to zero)

- Saturated Zone Only
  - –Mixing zone depth
  - –Aquifer thickness
  - –Hydraulic gradient

- Vadose and Saturated Zone
  - –Area of waste disposal unit (for each contaminant at each SWMU)
  - –Duration of pulse (as calculated from the GWM spreadsheet)
  - –Initial concentration at source (based on analytical data)
  - –Normalized Distribution Coefficient, K_{oc} (for each contaminant)
  - –Distribution Coefficient, K_d (for each contaminant)
  - –Biodegradation Coefficient (set to zero)

The thickness of the unsaturated zone dictated the distance a contaminant would have to travel to reach the aquifer should contaminant migration occur. This important input parameter was estimated using field data collected at TEAD-N during previous investigations. However, subsurface data were not available for a number of the SWMUs for which modeling was completed (i.e., no deep borings or monitoring wells have been completed at these locations). For these SWMUs, the vadose zone thickness was estimated using the TEAD-N groundwater surface contour map created using groundwater elevation data collected from wells located across the site (see Figure 1-7 in Section 1.5.5.3). Table 2-27 presents these parameters.

The rest of the MULTIMED input parameters were held constant for all of the model simulations. The following is a list of these parameters and corresponding applied values:

Table 2-27. Summary of SWMU-Specific Model Input Parameters

SWMU	Vadose Zone Thickness (cm)	Area of Soil Contamination (cm)	Thickness of Soil Contamination (cm)	Distance to Off-Site Receptor (m)	Saturated Zone Hydraulic Gradient
6	8,200	126,300	365	8,070	0.006
7 (Bullet Stop)	8,200	429,200	305	NA	NA
7 (Firing Point)	8,200	4,600	305	NA	NA
7 (North Trench)	8,200	38,900	305	NA	NA
8	10,688	4,528	30.5	8,250	0.0058
13	8,200	119,000	365	8,200	0.0058
22	12,000	115	305	NA	NA
23	16,764	25,230	90	NA	NA
31	9,906	16,165	30.5	NA	NA
32	9,906	232	305	NA	NA
35	10,668	142,650	30.5	NA	NA
36	8,200	6,505	152	NA	NA
40	10,700	140,460	213	6,200	0.0077

- Saturated hydraulic conductivity (for Vadose Zone) 36 cm/hr
- Unsaturated zone and aquifer porosity 0.43
- Residual water content 0.045
- ALPHA Van Genuchten Coefficient 0.145
- BETA Van Genuchten Coefficient 2.68
- Percent organic matter 0.05 percent
- Bulk density of soil layer and aquifer material 1.51 g/cm^3
- Hydraulic conductivity of aquifer 3,150 m/yr

Parameters associated with the vadose zone (soil bulk density, porosity, and residual water content) were estimated using geotechnical data from the current RI report (when available), the *TEAD-N Final Draft RCRA Facilities Investigation Report Phase II Study Known-Releases SWMUs* (Rust E&I 1994), or the *Groundwater Quality Assessment Report* (JMM 1988). Hydraulic conductivity estimates were based on slug test data presented in the Rust 1994 RFI report.

For the saturated zone, when applicable, parameters for hydraulic conductivity, soil bulk density, and porosity were set similar to the vadose zone . The temperature of the aquifer and the pH were based on well-development data contained in the Rust 1994 RFI report.

The majority of the chemical module parameters were inactive or set to 0. Only three parameters required input: the normalized distribution coefficient (K_{oc}); distribution coefficient (K_d); and biodegradation coefficient. Values for K_{oc}, K_d, and the biodegradation coefficients were found in Montgomery (1991) and Kennedy (1992). In keeping with the conservative approach, soil organic carbon content and K_d values that minimized retardation of the contaminants were selected.

2.7.3 Vadose Zone—Sensitivity Analysis

After the vadose zone MULTIMED simulations were completed, a number of the input parameters were altered from their assigned value to obtain a range for the final break-through times and COPC concentrations. This analysis was necessary since many of the input values were estimated. The parameters estimated from field data and considered to be real estimates rather than conservative estimates were chosen for the vadose zone sensitivity analysis. These input parameters are as follows:

- Hydraulic conductivity (cm/hr)
- Longitudinal dispersion (m)
- Porosity (dimensionless)
- Infiltration rate (m/yr)
- Size of source area (m^2)
- Vadose zone thickness (m)

All of the remaining input parameters were estimated from the literature using the most conservative approach. As indicated in Tables 2-28, 2-29, 2-30, and 2-31, the parameters that affect the break-through time the most are longitudinal dispersion and infiltration rate. The remaining four input parameters tested in this sensitivity analysis showed only a minimal impact on the break-through time.

SWMUs 6 and 22 were chosen for the sensitivity analysis, primarily because they had varying distances to the water table from the source area (82 meters and 120 meters, respectively). Additionally, the COPCs for cadmium and 2,4,6-trinitrotoluene were chosen at each SWMU because they each have different and distinct transport characteristics in the vadose zone and the aquifer. A brief discussion of the results concerning each parameter in the sensitivity analysis is contained in the following paragraphs.

2.7.3.1 *Hydraulic Conductivity*

The hydraulic conductivity for all of the vadose zone simulations was determined from previous studies and from single well tests conducted by Rust E&I. The initial value was 36 m/yr; this value was varied from 3.6 to 360 m/yr for the purpose of the sensitivity analysis. This range in hydraulic conductivity is consistent with those described by the summary report published by the State of Utah, Department of Natural Resources (1994).
The resulting break-through time ranges are shown in Tables 2-28, 2-29, 2-30, and 2-31. There is little variation in break-through time indicated by these simulations.

2.7.3.2 *Longitudinal Dispersion*

The initial value in the vadose zone model, calculated from other conservatively estimated input parameters, was 9.75 meters (m). This value is generally much higher than those observed in the literature (Freeze and Cherry 1979). However, since longitudinal dispersivity does have an impact on the break-through time, it is important to mention it here and show this impact. A more realistic value for the porous media underlying TEAD is thought to be approximately 0.1 m. The impact of varying this parameter is significant when increasing the value upward to 19.75 m but is not as significant when varying this value downward to 0.97 m (Tables 2-28, 2-29, 2-30, and 2-31). The range of values given from experimental data in the MULTIMED manual range from .0022 to 0.70 m, suggesting that the MULTIMED solution becomes non-linear as this input parameter is adjusted upward. Therefore, it is assumed that the value of 9.75 m is conservative and appropriate for this model as it is applied as a screening tool. In the sensitivity analysis simulations, the lower value of 0.97 m often does not show a change in break-through time. This is due to the fact that the time step in the simulation is larger than the difference in break-through time.

Table 2-28. MULTIMED Sensitivity Analysis for Cadmium at SWMU 6

	Vadose Zone						Results	
Simulation Number	Hydraulic Conductivity (cm/hr)	Longitudinal Dispersion (m)	Porosity	Infiltration Rate (m/yr)	Source Area (m^2)	Vadose Zone Thickness (m)	Breakthrough Time (yrs)	Breakthrough Concentration (mg/L)
1	3.60E+01	9.75E+00	0.43	0.088	1.26E+05	8.20E+01	850	1.19
2	3.60E+02						850	1.61
3	3.60E+00						850	0.45
4		1.97E+01					160	0.41
5		0.97					850	1.01
6			0.5				850	1.01
7			0.25				850	1.65
8				0.2			400	13.6
9				0.02			3600	0.006
10					1.26E+06		850	3.76
11					1.26E+04		850	0.376
12						92	950	0.31
13						71	750	2.3

Table 2-29. MULTIMED Sensitivity Analysis for 2,4,6-TNT at SWMU 6

	Vadose Zone						Results	
Simulation Number	Hydraulic Conductivity (cm/hr)	Longitudinal Dispersion (m)	Porosity	Infiltration Rate (m/yr)	Source Area (m^2)	Vadose Zone Thickness (m)	Breakthrough Time (yrs)	Breakthrough Concentration (mg/L)
1	3.60E+01	9.75E+00	0.43	0.088	1.26E+05	82	378	0.00013
2	3.60E+02						378	0.61
3	3.60E+00						403	0.47
4		1.97E+01					53	0.0075
5		0.97					403	1.46
6			0.5				403	1.29
7			0.25				378	0.66
8				0.2			178	2.57
9				0.02			1700	0.057
10					1.26E+06		378	0.00041
11					1.26E+04		378	0.00004
12						92	453	1.13
13						72	328	0.296

Table 2-30. MULTIMED Sensitivity Analysis for 2,4,6-TNT at SWMU 22

	Vadose Zone						Results	
Simulation Number	Hydraulic Conductivity (cm/hr)	Longitudinal Dispersion (m)	Porosity	Infiltration Rate (m/yr)	Source Area (m^2)	Vadose Zone Thickness (m)	Breakthrough Time (yrs)	Breakthrough Concentration (mg/L)
1	3.60E+01	9.75E+00	0.43	0.088	1.26E+05	120	563	335
2	3.60E+02						563	552
3	3.60E+00						603	523
4		1.97E+01					243	101
5		0.97					563	301
6			0.5				563	251
7			0.25				563	568
8				0.2			283	3274
9				0.02			2500	31.9
10					1.26E+06		563	1071
11					1.26E+04		563	97.7
12						130	603	116
13						110	563	547

Table 2-31. MULTIMED Sensitivity Analysis for Cadmium at SWMU 22

	Vadose Zone						Results	
Simulation Number	Hydraulic onductivit (cm/hr)	ongitudina Dispersion (m)	Porosity	Infiltration Rate (m/yr)	Source Area (m^2)	Vadose Zone Thickness (m)	Breakthrough Time (yrs)	Breakthrough Concentration (mg/L)
1	3.60E+01	9.75E+00	0.43	0.088	1.26E+05	120	1250	0.012
2	3.60E+02						1250	0.014
3	3.60E+00						1250	0.0075
4		1.97E+01					550	0.003
5		0.97					1250	0.011
6			0.5				1250	0.011
7			0.25				1250	0.014
8				0.2			650	0.133
9				0.02			5300	0.0003
10					1.26E+06		1250	0.037
11					1.26E+04		1250	0.0034
12						130	1350	0.0078
13						110	1150	0.016

2.7.3.3 *Porosity*

The initial input value for the vadose zone screening model was 0.43 and was estimated from the literature. This value was increased to 0.5 for the upper limit and 0.25 for the lower limit in the sensitivity analysis. As shown in Tables 2-28, 2-29, 2-30, and 2-31, there is no significant difference in break-through times in the porosity simulations. However, a difference in break-through concentrations was observed. Since the vadose zone model was designed to be used as a screening tool in which the break-through time was the most important output parameter, this concentration difference is not considered significant. Additionally, in all vadose zone screening simulations, the initial pore water concentration was considered to be an extremely conservative estimate since mineral-solution equilibrium and degradation effects were ignored.

2.7.3.4 *Infiltration Rate*

This parameter was estimated using an infiltration model as described in the previous sections and using actual precipitation data. This parameter was initially set to 0.088 m/yr and increased to 0.2 m/yr for the upper limit and decreased to 0.02 m/yr for the lower limit. As shown in Tables 2-28, 2-29, 2-30, and 2-31, there is a very distinct variation in the break-through times and break-through concentrations as a result of these input changes. Since varying this parameter would result in significant changes to the results, it is important to make the best estimate possible based on the precipitation data and the soil type. For this reason, PRZM-2 was utilized to calculate this infiltration rate. The PRZM-2 model set up and explanation are contained in the preceding sections (Section 2.7.2.2). Given the available data, it is estimated that the 0.088 m/yr input value is appropriate for this model application and should not be varied.

2.7.3.5 *Source Area*

The area of contaminated soil for each SWMU was estimated from field data. This initial estimate was varied upward and downward by an order of magnitude. As shown in the following four tables, there is no significant variation in break-through time; however, there is a variation in break-through concentration. This may be attributed to more contaminant mass being available to pore water solution over a larger area. This variation is approximately one order of magnitude different in concentration for every two orders of magnitude variation in source area. Since this model is used as a screening tool for break-through time, this concentration difference is not important. However, if break-through concentration does become an important factor, further refinement of the model should be considered.

2.7.3.6 *Vadose Zone Thickness*

Since water level fluctuations are always a dynamic process in aquifers, it is important to

understand the impact that these variations may have on this screening process. Therefore, the vadose zone thickness was varied 10 meters upward and 10 meters downward from the initial input values. The results in the following four tables show an almost linear relationship between the changes in this input parameter and the resulting break-through times. Since most of the remaining parameter estimates are based on a very conservative approach, it is appropriate to use this screening tool with our best estimate of the vadose zone thickness as described earlier in this section.

2.7.3.7 *Conclusions*

In summary, the above sensitivity analysis indicates that parameter estimates do affect the break-through time and break-through concentrations. However, due to the ultra conservative approach to the remaining input parameters and the fact that mineral-solution equilibrium relationships and COPC degradation are ignored, the MULTIMED model, as applied herein, is an appropriate screening tool.

3.0 RISK ASSESSMENT METHODOLOGY

3.1 BASELINE HUMAN HEALTH RISK ASSESSMENT METHODOLOGY

As part of the Phase II RI, a baseline risk assessment (RA) was conducted to estimate potential human health risks associated with the no-action alternative for those SWMUs listed in Table 3-1. The following tasks were completed in the RA:

- Data analysis and selection of COPCs
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Summary and conclusions

This section provides an overview of the methodology used in the RA by describing the general approach to each step of the RA. Not all pathways evaluated in the RA applied to each SWMU or grouping (OU) of SWMUs. For example, OU 4 (SWMUs 31, 32, and 35) is not part of any grazing allotment (Rust E&I 1994a). In addition, some scenarios (e.g., off-site residents) contain pathways affected by more than one SWMU.

The initial step of the RA involved data analysis for usability and the selection of those chemicals present at each SWMU that may be of potential concern from a human health and/or an environmental risk perspective. After identification, an exposure assessment was performed to estimate the magnitude of potential human contact with the SWMU-related chemicals.

The toxicity assessment was then conducted to review the available information related to the inherent chemical toxicity of each COPC. The next step was a risk characterization. In this step, the magnitude and probability of current and future potential human health risks associated with the COPCs were estimated. Uncertainties associated with this risk assessment process and the impact of these uncertainties were also discussed. The final step was to provide conclusions that can be drawn from the risk assessment and any recommendations for subsequent action based on health considerations.

SWMU-specific information—including actual chemicals evaluated, exposure scenarios and parameters, risk estimates, and uncertainties—is presented in subsequent Sections 4.0 through 6.0 of this report. Detailed appendices provide complete exposure and risk models, as well as toxicity data for the chemicals under evaluation.

3.1.1 Methodology for Identifying Chemicals of Potential Concern

The objective of this step was to identify COPCs for each of the SWMUs listed in Table 3-1. This RA utilized data collected as part of both the Phase I and the Phase II field activities.

Table 3-1. Phase II SWMUs Evaluated in the RA for TEAD-N

Operable Unit	SWMU No.	SWMU Name
4	31	Former Transformer Boxing Area
	32	PCB Spill Site
	35	Wastewater Spreading Area
8	6	Old Burn Area
	7	Chemical Range
	13	Tire Disposal Area
	22	Building 1303 Washout Pond
	23	Bomb and Shell Reconditioning Building
	36	Old Burn Staging Area
9	8	Small Arms Firing Range
	40	AED Test Range

The following data attributes were considered for each sample analyzed (USEPA 1992a):

- Sample description
- Sample locations
- Analytical method and detection limit (MDL)
- Analytical results of the sample, including data qualifiers
- Sample quantitation limit (SQL)
- Field conditions existing during sampling
- Sample documentation (CoC and SOPs)

Data lacking the above information were considered only for qualitative use in the RA.

3.1.1.1 *Data Usability Evaluation for Quantitative Risk Assessment*

Chemical data generated for the USAEC are collected and maintained in IRDMIS, an Ingress database. Data are first reviewed by the analytical laboratory (DataChem) and Rust E&I. The USAEC Chemistry Branch then evaluates method performance and qualifies data according to the USAEC Quality Assurance Program Plan and the *IRDMIS Data Dictionary*.

Final data usability is dictated by the data quality objectives and final data quality assessment. These criteria are not included in the USAEC database but must be evaluated separately. When all steps are complete, data suitable for use in quantitative risk assessment can be identified.

The objective of the Rust E&I data quality assessment is to provide a complete, valid data set for use by human health and ecological risk assessors. To assist in developing this data set, the following assumptions were developed as reasonable and conventional for chemical data produced under a USAEC environmental program.

- Standard, approved methods were used to generate the chemical data.
- Accuracy and precision are appropriate and acceptable for all unqualified data.
- Qualified data are usable as long as they meet the quality requirements of a risk assessment.
- The integrity of the data is intact.
- A complete set of chemical data is achievable.
- The data have satisfied quality criteria established for TEAD-N.
- Data are comparable to other data collected at the same site within the same time frame by all contractors.

The chemical data set included Phase I and Phase II sample data. Phase I data resulted from investigations during 1992. Phase II data are the most current data, derived from investigations during 1994 and 1995. The phases were kept separate for the data quality assessment. Electronic data processing checks were completed to further verify data quality. Quality control or data affected by quality control samples were removed as follows:

- Any filtered metal data were removed.
- Tentatively identified compounds (TICs) were removed.
- Field quality control samples such as equipment rinse blanks, trip blanks, and matrix spike samples were removed.
- Laboratory quality control samples such as method blanks, laboratory control spikes, duplicates, and matrix spike samples were removed.
- Data qualified as rejected (data qualifier "R") were removed.
- Duplicate data from two different methods were handled in the following manner: For a given sample, if there was a detection with one method, the detected value was used in the risk assessment. If both values were detects, the highest detected value was used. If both values were nondetects, ½ of the lower nondetect value was used.
- Field duplicates were compared to the primary investigative results, and the higher of the two values was used in the quantitative risk assessment.
- All data collected using the same equipment type from the same medium were compared to field blank data based on the 5x/10x rule (USEPA 1989a; USEPA 1992a).
- All volatile compound samples collected on the same day were compared to trip blank data based on the 5x/10x rule (USEPA 1989a; USEPA 1992a).
- Samples were compared to method blank data based on the 5x/10x rule, as appropriate (USEPA 1989a; USEPA 1992a).

At this point, the chemical data were divided into the respective SWMUs. Individual SWMU data sets were reviewed for qualifiers. Any impact to the SWMU data set was documented. The quality assessment for individual SWMUs is discussed in subsequent sections of this document.

EcoChem functioned as the independent, third-party validation team and used PAM 14-11 and applicable quality indicators from the *1994 USEPA Functional Guidelines for Organic and Inorganic Data Validation*. The EcoChem validation process was used to review blanks, calibrations, interferences, standards, preparation, and analyses as provided in the USAEC stand-alone data packages for each SWMU. The validation results are presented in each individual SWMU section.

3.1.1.2 *Chemicals of Potential Concern Selection*

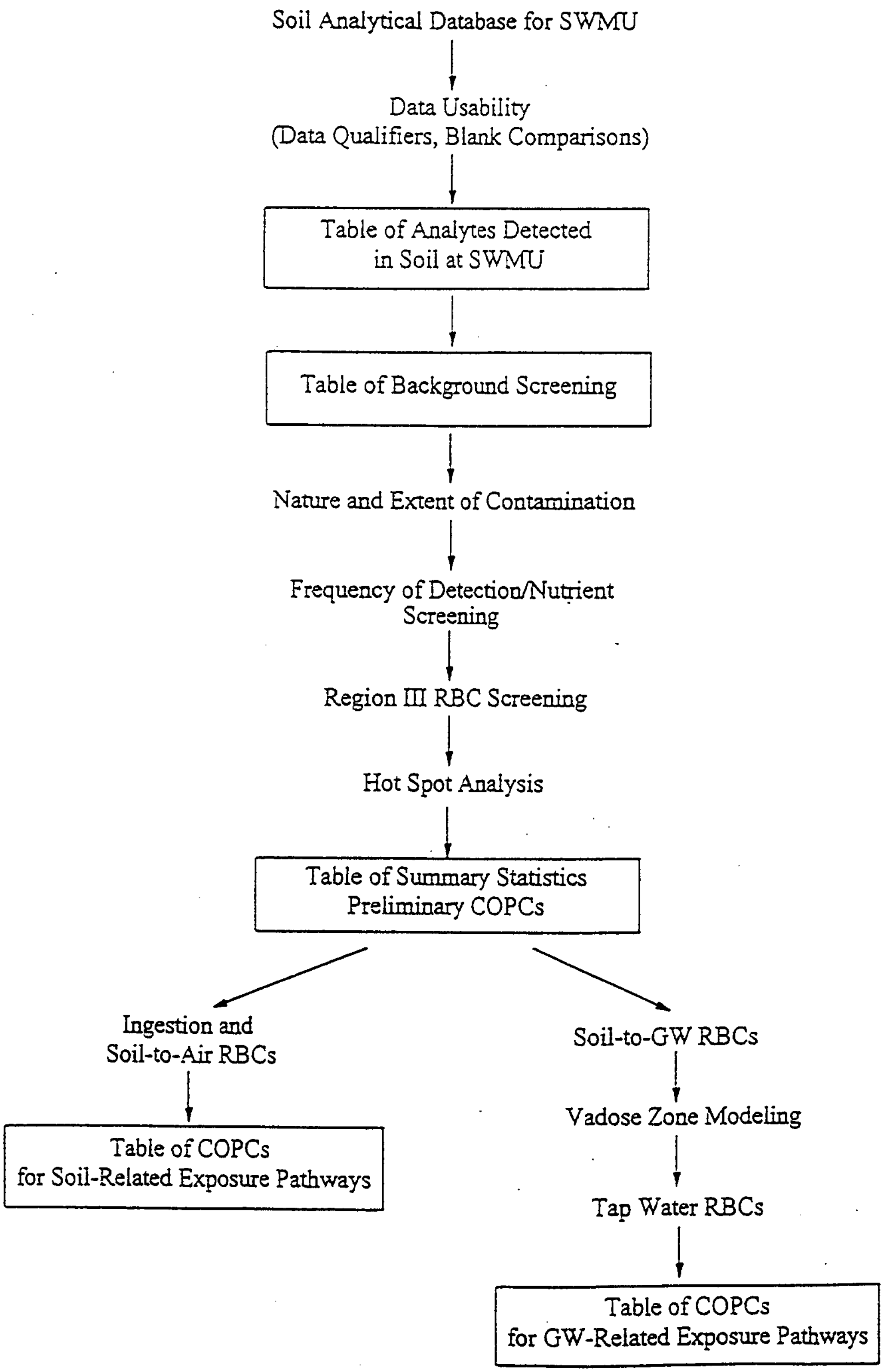
The COPC selection process incorporated guidance from the following documents: *Risk Assessment Guidance for Superfund (RAGS), Vol. 1; Human Health Evaluation Manual (Part A)* (USEPA 1989a); *Calculating the Concentration Term* (USEPA 1992); *Region 8 Superfund Technical Guidance* (USEPA 1994); and "Region III Risk-Based Concentration Table, July - December 1995" (USEPA 1995). To focus the Risk Assessment on those site-related chemicals that present the greatest potential risk, the chemicals in each medium were screened in a step-wise fashion to obtain a set of COPCs for each SWMU. This screening process included the following steps, which are summarized in the flow chart in Figure 3-1.

1. Data Usability—The entire soil analytical database for each SWMU was first reviewed for data usability. This step included the application of USEPA data qualifiers, comparison of site sample results to blank results, and an assessment of data completeness and representativeness for the SWMU. The complete process is described in detail in Section 2.4. A table showing sample-specific analytical results for all detected chemicals at a SWMU was then generated.

2. Background Screening—In this step, inorganic chemicals detected in the soil were compared to background screening threshold values. The derivation of these background screening values is described in detail in Section 2.6. An inorganic chemical was eliminated from the database if every sample result was less than its background threshold value. Surface soil and subsurface soil were screened separately. A table is presented that summarizes the background screening process for each site. At this point, the nature and extent of site contamination at the SWMU was described.

3. Nutrient Screening/Frequency of Detection—According to the Region VIII Superfund Technical Guidance, essential nutrients do not have to be considered further in the risk assessment if they are present at low concentrations. For this RA, nutrient screening values were calculated for nutrients in the soil database without toxicity values (i.e., calcium, magnesium, iron, potassium, and sodium). The nutrient values were calculated using CERCLA guidance for the derivation of preliminary soil remediation goals (PRGs)

Figure 3-1. Flowchart for Selection of SWMU-Specific COPCs



for a residential scenario (USEPA 1991). The U.S. recommended daily allowance (RDA) was substituted for the toxicity value in the equation, and the target hazard quotient was 1.0. The RDAs were taken from the Region VIII guidance. In those instances where the calculated nutrient screening value exceeded 1E+06 mg/kg (calcium, magnesium, and sodium), the value of 1E+06 was used as the screening value.

Since an RDA was not provided for sodium (Na^+), a review of the medical literature was conducted to determine a safe level of human consumption for this nutrient. Uncomplicated hypertensive patients should not consume more than 4 to 6 grams of salt (1,600 to 2,400 mg Na^+) per day (Rakel 1990; Wyngaarden *et al.* 1992). The value of 1,600 mg Na^+ of salt per day was therefore selected as a safe human consumption level. Assuming an adult body weight of 70 kilograms (kg), a safe dose for sodium is approximately 20 milligrams per kilogram per day (mg/kg-day).

Table 3-2 summarizes the calculated nutrient screening values for this RA. A nutrient was eliminated from the database if all investigative results were lower than the nutrient screening value.

Table 3-2. Nutrient Screening Values

Nutrient	RDA[a](mg/kg-d)[b]	Nutrient Screening Value (mg/kg)
Calcium	14	1,000,000
Magnesium	5.7	1,000,000
Iron	0.26	70,000
Potassium	0.57	150,000
Sodium	20	1,000,000

[a]U.S. recommended daily allowance.
[b]Milligrams per kilogram per day.

Chemicals that are infrequently detected may be sampling or analytical artifacts unrelated to site operations. Such chemicals may be eliminated from the quantitative risk assessment if there is no reason to believe that the chemical may be present (USEPA 1989a). For this RA, a chemical was eliminated from the analytical database if it was detected in 5 percent or fewer of the samples and if the history of the site suggested that it would not be expected to be present. This step of COPC selection process was not conducted for SWMUs or areas of concern with a small sample size (i.e., less than 20).

4. Region III Risk-Based Concentration Screening—An analysis was first undertaken to determine if "hot spots" of contamination exist at the SWMU, which would warrant separate evaluation. The process involved reviewing contaminant distribution across the SWMU, the distance separating sample locations, and the size of the SWMU with respect to a hypothetical 0.5-acre residential lot. In some instances, screening against risk-based

concentrations (RBCs) was performed to aid in the determination of hot spots. The rationale underlying the hot spot analysis is described in detail for each SWMU. A table of summary statistics is provided for preliminary soil COPCs at each area of concern. This table includes frequency of detection, range of detections, range of CRLs, arithmetic mean concentration, the 95 percent upper confidence limit (UCL) of the mean, and exposure point concentration (EPC) for each preliminary COPC.

Preliminary COPCs were then further screened against EPA Region III RBCs (USEPA 1995) to obtain the final list of COPCs for each site. The following two types of COPCs are generated in this process:

- COPCs for Soil-related Exposure Pathways—COPCs for soil-related exposure pathways (incidental ingestion, dermal contact, inhalation, vegetable ingestion, beef ingestion) were selected from the preliminary COPCs by screening their calculated EPCs against the Region III residential soil ingestion and soil-to-air RBCs. One-tenth of the RBC was used for noncarcinogens, and the 10^{-6} cancer risk RBC was used for carcinogens. Where one or both of these RBCs were not provided in the Region III table, a value was calculated using the methodology described by Region III (USEPA 1995). If the EPC for a preliminary COPC exceeded either the soil ingestion or the soil-to-air RBC, the chemical was retained as a COPC for the soil-related exposure pathways.

- COPCs for Groundwater-related Exposure Pathways—To select COPCs for the groundwater exposure pathways, the maximum concentration of a chemical detected in either surface or subsurface soil at the site was compared to the Region III soil-to-groundwater RBC. One-tenth of the value was used for noncarcinogens; the 10^{-6} cancer risk RBC was used for carcinogens. When a chemical-specific RBC was not provided in the Region III table, a soil-to-groundwater RBC was calculated using the methodology described by Region III (USEPA 1995). Any chemical that had a maximum soil concentration that exceeded the soil-to-groundwater RBC was retained for site-specific vadose zone modeling. Subsequently, vadose zone modeling was used to estimate the potential COPC travel time to the water table directly underlying the site. If the travel time was greater than 100 years, the chemical was not selected as a COPC for quantitative risk assessment. If the travel time estimates were less than 100 years, the chemical was modeled to an on-site and off-site hypothetical receptor using the vadose zone and saturated zone modules in MULTIMED. For this vadose zone/saturated zone model, the average contaminant concentration observed in surface and subsurface soil samples was used to determine the initial pore water concentration at the site (see Section 2.7.2). The results of the vadose zone/saturated zone modeling were then compared to the Region III tap water RBCs. One-tenth of the value was used for noncarcinogens; the 10^{-6} cancer risk RBC was used for carcinogens. When a chemical-specific RBC was not provided in the Region III table, a tap water RBC was calculated using the methodology described by Region III (USEPA 1995). If the modeled concentration of a preliminary COPC exceeded the tap water RBC, the chemical was selected as a COPC for quantitative risk assessment for the groundwater exposure pathways.

3.1.2 Exposure Assessment

The objective of the exposure assessment was to assess how exposures to COPCs could occur and to estimate the extent of potential exposure. The exposure assessment included several activities:

- Characterization of the exposure setting for which exposure may occur, including exposed populations, sensitive subpopulations, and the dynamics of their exposure

- Identification of potential exposure pathways based on chemical source and release, chemical fate and transport mechanisms, point of exposure, and exposure route

- Identification of complete exposure pathways

- Estimation of chemical intake for the complete exposure pathways

- Identification of the uncertainties associated with the exposure assessment that affect the risk characterization

The first four steps define the exposure scenario development. Components of an exposure scenario included a chemical source, mechanisms that facilitate the transport of chemicals from sources through various environmental media, potential receptors and the behaviors and activities that could lead to exposure, and a route for exposure of those receptors.

3.1.2.1 *Characterization of Exposure Setting*

The first step in developing exposure scenarios was to characterize the site setting in which potential exposures might occur. The site setting was evaluated first in the development of exposure scenarios because the characteristics of the site setting influenced the types of transport mechanisms and the type of receptor exposure that could occur. Once the physical setting was evaluated, data from that evaluation were used to define sources, potential migration pathways, and exposure points.

Identifying the potential receptors (either real or, in the case of site redevelopment for alternative use, hypothetical) was the final step in characterizing the exposure setting. This was necessary because an exposure scenario could not be completely developed if it was not reasonable to conclude that activities of identified receptor populations in the vicinity of the site could lead to potential exposures. Assessment of potentially exposed populations considered both current land use and predicted future land use. The potential depot-wide receptors are summarized below in terms of current and future land use. The applicability of these receptor populations to a given SWMU is discussed in the SWMU-specific sections of the report.

3.1.2.1.1 *Current Land Use*. Public access to portions of the facility that remain as part of the TEAD-N mission is controlled, thereby precluding transient exposure. On-base housing for both civilians and military families is located in the administrative area of TEAD-N. There are 17 military personnel with 17 dependents and 20 civilian personnel with 42 dependents currently living in on-base housing, for a total of 96 people. The average residence time is approximately 3 years (S. Culley, personal communication with Rust E&I, 1994). No produce (i.e., vegetables, fruit) is grown at TEAD-N. Tooele Alternative High School, a 4-year alternative high school, is located within the administrative area (Building 111); it has 42 full-time and 100 part-time (2 hours per week) students (Rust E&I 1994a). Several private businesses have leased buildings in the maintenance area of the BRAC parcel. Transient exposure to SWMUs in the area, however, is expected to be minimal.

The land surrounding TEAD-N is predominately undeveloped and used for livestock grazing, rangeland, and limited cultivation. Residential development within the city of Tooele abuts the northern boundary of TEAD-N. Populations potentially exposed to SWMU-related chemicals are residents of Tooele, Stockton (approximately 3 miles to the south), and Grantsville (approximately 2 miles to the north). Potentially sensitive subpopulations in these areas would be children, students in Grantsville and Tooele public schools, and patients in hospitals. There are no public schools in Stockton. The number of students enrolled in Grantsville and Tooele public schools are 1,530 and 4,088, respectively (Rust E&I 1994a).

Based on the above information, along with review of census reports and discussions with representatives of TEAD-N, the Tooele County Economic Development Agency, and the Utah State University Extension Service, potential receptors under current land use were defined as:

- Depot staff—Primarily composed of military and civilian office staff in the main depot complex.

- SWMU-specific workers and security personnel—Individuals with job descriptions that call for repeated, light to moderate labor in the general vicinity of a specific SWMU and staff assigned to maintenance of perimeter or other security that repeatedly brings them in the vicinity of a SWMU or SWMUs.

- Installation residents—Military and civilian personnel and dependents living on the depot.

- Students and employees—Those of Tooele Alternative High School.

- Off-site residents—Military personnel and/or civilians living near the depot perimeter.

- Consumers—Individuals who ingest beef obtained from cattle grazed on TEAD-N pasture.

3.1.2.1.2 *Future Land Use*. Under the BRAC plan, approximately 1,700 acres comprising the maintenance and administrative areas of the depot were scheduled to be turned over to the Tooele County Economic Development Corporation (TCEDC) in 1995 through an interim lease (L. McFarland, TCEDC, personal communication with Rust E&I, 1994). To date, none

of the 1,700 acres have been turned over. The Tooele County Economic Development Agency (EDA) is in the process of preparing an application for an Economic Development Conveyance (EDC) of the entire 1,700-acre parcel. In the interim, the Army is pursuing the interim lease of a number of facilities in cooperation with the EDA. To date, several leases of buildings to private businesses are in place and several others are pending.

The majority of the land (1,350 acres) is planned to remain in industrial use, possibly as an addition to the Tooele Industrial Park complex. Some 390 of the 1,700 acres are undeveloped, including approximately 122 acres that either are a part of or abut the Wastewater Spreading Area (SWMU 35). The TCEDC plan recommends that these currently undeveloped areas be converted to residential and recreational use (e.g., golf course, playground, park, open space).

The remainder of the depot will continue its current mission into the foreseeable future. It is expected that use of open space as pasture will continue. Some exposure scenarios that are analogous to current-use scenarios described above will continue (i.e., depot staff). Therefore, three additional exposure scenarios unique to planned or potential future use were developed:

- Skilled laborers—Individuals assigned to short-term construction in the vicinity of a SWMU or SWMUs during potential redevelopment.

- Recreational users—Individuals who use leased land for recreational purposes.

- Inhabitants of an on-site residence(s)—Individuals who reside in houses established at the time that depot property is transferred for redevelopment.

3.1.2.2 *Characterization of Potential Exposure Pathways*

An exposure pathway is the route COPCs take to reach potential receptors. USEPA risk assessment guidance (USEPA 1989a) suggests eliminating an exposure pathway from detailed analysis when there is sound justification for elimination. USEPA guidance (USEPA 1989a) offers examples of justification for eliminating exposure pathways. For example, an exposure pathway may be excluded from consideration if:

- Exposure resulting from the pathway is much less than that from another pathway involving the same medium at the same exposure point.

- Potential magnitude of exposure from an exposure pathway is low.

- Probability of the exposure occurring is very low and the risks associated with the occurrence are not high.

An exposure pathway was selected for further evaluation only if it was complete or, in the case of future exposure, potentially complete. A complete exposure pathway generally is comprised of four basic components: (1) source, (2) mechanism(s) for release and transport to the point of receptor exposure, (3) receptor(s) present at a point where chemicals are present,

and (4) mechanism(s) for exposure of the receptor to the chemicals containing media. Exposure pathways were eliminated from quantitative evaluation if any of the four components were absent. The following tables (Tables 3-3 and 3-4) present the pathway summaries, and Figure 3-2 illustrates potential exposure pathways.

Some pathways are discussed qualitatively. These pathways are bounded by others with equal or longer exposure periods and duration (e.g., site-specific workers, construction workers, or recreational users).

One of the identified pathways has receptors that are not SWMU-specific: consumption of beef from grazing allotments comprising one or more SWMUs. Aspects of the assessment approach to this pathway are discussed below. Applicability of other pathways to each SWMU is discussed in the appropriate section.

Cattle grazing is permitted at TEAD-N, with grazing allotments competitively bid and leased every 5 years to a single rancher. The current lease is up for rebid in 1996. Grazing at TEAD-N typically occurs between October 15 and May 31, with calving taking place in January. The calves remain at the facility until May 31 when they are either moved to feedlots or to other grazing areas. The calves typically do not return to TEAD-N after their initial exposure, and they are eventually sold as slaughter cattle for human consumption. Distribution is through regional and national distribution networks. The cows are normally utilized as breeding stock and may or may not return to the site during consecutive years. The current lessee brings approximately 1,000 head, mostly heifers, to winter pasture at TEAD-N and maintains summer pasture in Idaho (M. Walker, personal communication with Rust E&I, 1994).

To evaluate potential health risks associated with the consumption of beef cattle grazed on TEAD-N, as well as produce that in the future may be grown on site, it was necessary to model COPC concentrations in plants grown in soils potentially affected by site conditions.

It was assumed that the duties of the on-site laborer/security personnel would require the individual to travel from SWMU to SWMU or traverse a specific SWMU during a normal work-day. For this reason, this receptor was evaluated for two exposure settings to encompass all potential exposure scenarios. The two exposure settings include area-of-concern-specific and the SWMU-as-a-whole.

For all receptors except the construction worker, the air pathway (i.e., inhalation of particulates) is evaluated on a SWMU-wide basis not by area of concern. Air emissions were not evaluated for each specific area of concern. It was assumed that the SWMU, as a whole, was the main source for air emission generation for all on-site receptors. Air emissions of SWMU-related chemicals can occur by either direct volatilization or by entrainment from wind erosion of particulate-bound COPCs. With entrainment, it is assumed that small amounts of the organic compounds or heavy metals are adsorbed onto the surface of dust (soil) particles. At ambient temperatures, heavy metals can only become airborne by entrainment whereas organics can become airborne through either entrainment or volatilization. However, some organics strongly adsorb to soils and exhibit low volatilization rates.

Table 3-3. Exposure Pathways

Exposure Pathway	Depot Staff	SWMU-Specific Laborer	Beef Consumer	Installation Resident/ Student	Off-site Resident
Dermal contact with soil		X			
Ingestion of soil		X			
Inhalation of dust	X	X		X	X
Beef ingestion			X		

Table 3-4. Additional Future-Use Exposure Pathways

Exposure Pathway	Construction Worker	Recreational User	On-site Resident
Dermal contact with soil	X	X	X
Ingestion of soil	X	X	X
Inhalation of dust	X	X	X
Ingestion of produce			X
Ingestion of groundwater			X

A volatilization emission analysis was performed (SEC Donohue 1992b) using a volatilization release estimation equation designed for chemicals spilled or incorporated into soils (USEPA 1988a). Results from this analysis indicated negligible air quality impacts derived from volatilization releases from SWMUs located on TEAD-N. In addition, results from previous modeling conducted for adjacent sites with similar VOC concentrations revealed insignificant releases (SEC Donohue 1992b).

Preliminary results showed negligible chemical concentrations in the soil located at the closest installation boundary (SEC Donohue 1992b). Based on this, incidental soil ingestion and dermal contact were not considered potential risk contributors to human receptors located apart from the operable units. Although off-site residents may engage in vegetable gardening, these results indicate that the potential impact on homegrown produce through aerial deposition and root uptake would be negligible. Therefore, produce from off-site gardens was not quantitatively evaluated.

Risks were estimated for hypothetical off-site residents via inhalation of windblown particulate only for those SWMUs adjacent or near to the TEAD boundary. The rationale for this evaluation is that SWMUs interior to the depot would not provide a significant contribution (as a ground-level areal source) to this pathway. The following approach was used for those SWMUs interior to TEAD-N:

- A site conceptual model (Figure 3-2) has been used to demonstrate the inhalation of resuspended particulate-bound metals is a secondary pathway in terms of contribution to risk. This hypothesis is supported by risk estimates from those boundary SWMU for which a quantitative off-site assessment was undertaken.

- EPA Region III risk-based concentrations (RBC) for air (US EPA Region III, August, 1996) were used, where available, to screen modeled air concentrations of the metals for which verified inhalation reference doses or slope factors are not available. Region III on occasion ventures "outside" of agency-verified toxicity factors listed in IRIS or HEAST to develop these screening values. A table giving the screening results appears as part of the CoPC selection section for those SWMU specifically affected.

Plant uptake will vary with plant species and on a chemical-by-chemical basis. Because efforts to conduct bioassays were unsuccessful at TEAD-N, plant concentrations were estimated using published plant-chemical uptake factors (Baes et al. 1984; USEPA 1989c; Stevens 1992). Where uptake factors were not available, estimates were made using published methodologies employing the octanol-water partition coefficient (K_{ow}) (Travis and Arms 1988; McKone 1994).

For the subsurface soil pathways, it was assumed that the construction projects would be limited in size, therefore, potential exposure pathways are not evaluated for the SWMU as a whole but are limited to the specific areas of concern. The same theory was used to evaluate air pathways for this receptor.

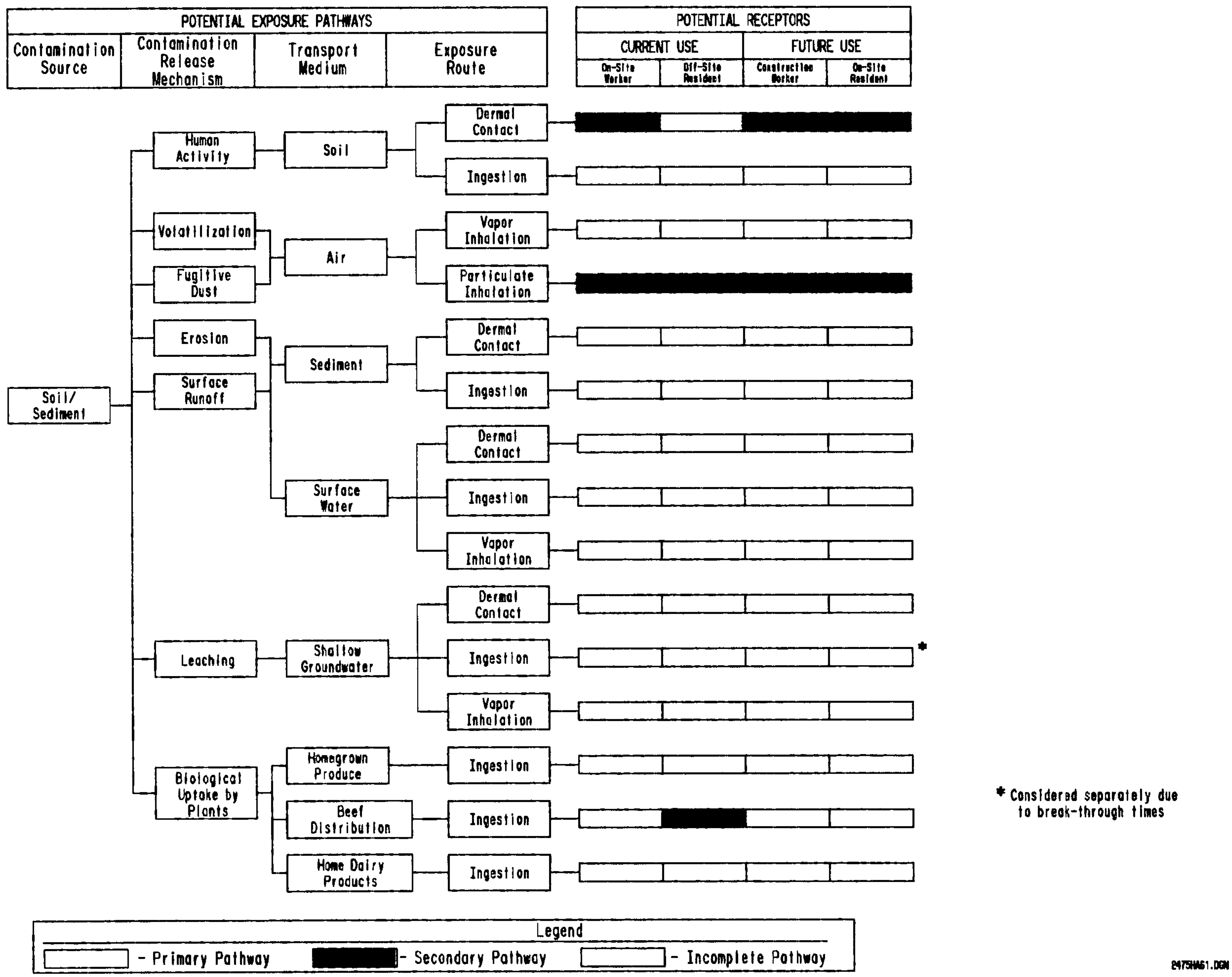


Figure 3-2. Potential Human Exposure Pathway Conceptual Model for Phase II RI SWMUs at TEAD

Exposure to COPCs in groundwater can potentially occur through the ingestion, dermal absorption, and inhalation pathways. Use of groundwater as a potable water supply for domestic purposes can entail the direct consumption of chemicals in drinking water, as well as dermal contact with chemicals and inhalation of VOCs during showering or bathing. Potential health risks associated with potential exposure to groundwater by future on-site residents were evaluated by modeling chemical migration from the sources to the groundwater and determining the concentration of each chemical reaching the groundwater as described in detail in Section 2.7.

For this RA, it was assumed that the groundwater pathway was complete for the hypothetical on-site adult resident at a well located within a SWMU boundary. Ingestion of groundwater is the only pathway which was quantitatively evaluated. Exposure from vapor inhalation while showering or bathing was not developed because no VOCs were COPCs for the hypothetical well. Because metals and explosives were the only COPCs modeled for this pathway, it was assumed that the ingestion pathway served as an upper bound estimate for on-site adult residential exposure, therefore the dermal contact pathway was not quantitatively evaluated.

3.1.2.3 *Derivation of Exposure Point Concentrations*

The EPC is defined as the concentration of a COPC in an exposure medium that will be contacted over a real or hypothetical exposure duration. Two exposure "cases" were evaluated: (1) reasonable maximum exposure (RME), which is defined by USEPA as the maximum exposure reasonably expected to occur at the site (USEPA 1989a), and (2) central tendency exposure (CTE), which may be defined as the "more-likely-to-occur" scenario. According to EPA guidance (USEPA 1992), the 95 percent UCL of the mean concentration or the maximum detected concentration at the site, whichever is less, was used as the EPC for both the RME and CTE exposure scenarios. EPCs were estimated based on the Phase I and Phase II data. Estimation of the EPC depends on several factors, including:

- Analytical chemical concentration data
- Statistical methods selected to assess the representative EPC
- Environmental persistence and degradation
- Potential contribution to COPC concentration from sources not related to the specific SWMU
- Location of the potential receptor
- Behavior of the potential receptor

EPCs at TEAD-N were evaluated for current-use scenarios in two different ways. When sufficient analytical data were available, measured concentrations were used. However, when the quality or quantity of analytical data was insufficient, modeled concentrations were used. For future-use scenarios, EPCs for organics represent medium-specific concentrations over time based on environmental half-lives from the scientific literature. This EPC is represented by the integral of the exponential decay equation over the assumed exposure interval (see Appendix L). EPCs for other COPCs were derived in a manner analogous to the current-use approach. Both the central tendency EPC and the RME EPC were derived based on agency

guidance considering the recent recommendations by the Science Advisory Board (SAB) (USEPA 1993).

3.1.2.4 *Estimation of Chemical Intakes*

The general methodology used to estimate chemical intakes for the RA are presented in this section. Pathway-specific parameters and equations, as well as models for plant uptake and transfer to beef tissue, are given in Appendix L. In general, the magnitude of chemical intake depends on the route of exposure (for example, ingestion, inhalation, or dermal absorption) and the variables affecting uptake by that route. These intake estimates are used with toxicity data to estimate risks for each potential pathway.

Chemical intake is normalized over time, and body weight is expressed as mass of chemical per kilogram of body weight per day, typically milligram (mg) per kilogram per day (mg/kg-day) (USEPA 1989a). The generic intake equation is:

$$I = (C \times IR \times EF \times ED) / (BW \times AT) \qquad \text{(Equation 3-1)}$$

where

I	=	Chemical intake (mg/kg body weight-day)
C	=	Chemical concentration (mass per unit volume or mass) in each medium
IR	=	Intake or contact rate (volume or mass/day)
EF	=	Exposure frequency (events or days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (period over which exposure is averaged) (days)

For confirmed and suspected carcinogens, the averaging time was the assumed lifetime of an individual, thereby yielding an estimated average lifetime daily intake. The averaging time for systemic toxicants was the appropriate exposure period. As SWMU-specific exposure pathways are identified, the above equation is modified to reflect the necessary parameters for modeling the given pathway.

3.1.3 Toxicity Assessment

The objective of the toxicity assessment task was to evaluate the chemicals considered in the RA for their potential to cause adverse human health effects through SWMU-specific transport and exposure mechanisms. The toxicity assessment is, in fact, a review of the scientific and regulatory literature concerning the nature and severity of the toxicological properties associated with the COPCs and the levels of exposure to a COPC that may result in a potential adverse health effect.

Information on the toxicological effects of carcinogens and systemic toxicants were summarized both qualitatively and quantitatively from available sources. The toxicity assessment (Appendix M) includes brief toxicity profiles based on recent, published literature. Among the quantitative information provided for each COPC is a toxicity value, such as the carcinogenic slope factor (CSF) and the reference dose (RfD). Among the primary sources that were used to identify the toxicity values are USEPA's *Integrated Risk Information System* (IRIS) database (USEPA 1995a) and the most current edition of the *Health Effects Assessment Tables* (HEAST) (USEPA 1994c). In addition, others sources in the regulatory and scientific literature were consulted as appropriate. Where the USEPA has not derived a pathway-specific toxicity value for a chemical, one was calculated, if appropriate, using USEPA guidance (USEPA 1989a). Surrogate values for certain chemicals were also used, where appropriate. Chemicals not evaluated quantitatively in the risk assessment are discussed in the uncertainty sections.

3.1.4 Risk Characterization

Risk characterization is the final step in the baseline risk assessment process and involves integrating the information developed in the toxicity assessment and the exposure assessment. Potential risks were characterized quantitatively for current and future baseline conditions using appropriate methods recognized by the regulatory community. These methods were health-protective and were likely to overestimate rather than underestimate risk. The objective of the risk characterization task is to place the estimates of risk in a SWMU-specific framework that facilitates risk management decisions. The risk characterization methods for chemicals exhibiting potentially carcinogenic and systemic effects are described below.

3.1.4.1 *Risk Assessment Methods—Potential Carcinogenic Effects*

The methods used to assess quantitatively the potential risk from exposure to confirmed or suspected carcinogenic chemicals is estimated as the incremental increase in the probability of an individual receptor developing cancer over a lifetime (incremental lifetime cancer risk or ILCR).

The following equation was used to calculate the incremental lifetime cancer risk at low doses (USEPA 1989a):

$$R_i = q_i^* d_i \qquad \text{(Equation 3-2)}$$

where

R_i = Incremental lifetime cancer risk for the i^{th} chemical as a unitless probability
q_i^* = Carcinogenic slope factor $(mg/kg\text{-}day)^{-1}$ for the i^{th} chemical
d_i = Chronic daily intake for the i^{th} chemical averaged over an assumed lifetime (mg/kg-day)

For estimating cancer risks from simultaneous exposure of a receptor to multiple chemicals from a single exposure route, the following equation is used:

$$R_T = \sum_{i=1}^{n} R_i \qquad \text{(Equation 3-3)}$$

where

R_T = Total pathway incremental lifetime cancer risk
R_i = Incremental lifetime cancer risk for the i^{th} chemical as a unitless probability

The appropriate total pathway risks were then summed for each receptor population that was addressed. This approach is based on USEPA's *Guidelines for Health Risk Assessment of Chemical Mixtures* (USEPA 1986a) and USEPA's *Guidelines for Carcinogenic Risk Assessment* (USEPA 1986b).

3.1.4.2 *Risk Assessment Methods—Systemic Effects*

The methods used to assess quantitatively the potential adverse health effects from exposure to systemic toxicants is estimated by comparing an exposure intake to a standard RfD. The ratio of intake to the RFD is termed the hazard quotient (HQ) (USEPA 1989a) and is defined as:

$$(HQ)_i = d_i/(RfD)_i \qquad \text{(Equation 3-4)}$$

where

$(HQ)_i$ = Hazard quotient for the i^{th} chemical (unitless)
d_i = Chronic daily intake for the i^{th} chemical (mg/kg-day)
$(RfD)_i$ = Reference dose for the i^{th} chemical (mg/kg-day)

For estimating the potential for adverse health effect from simultaneous exposure of a receptor to multiple chemicals from a single exposure route, the following equation is used:

$$HI = \sum_{i=1}^{n} (HQ)_i \qquad \text{(Equation 3-5)}$$

where

HI = Hazard index
$(HQ)_i$ = Hazard quotient for the i^{th} chemical (unitless)

The applicable exposure route HIs were then summed for each receptor population. When the receptor population HI value exceeded 1.0, the chemicals were segregated by critical effect

and target organ, and separate effect-specific HIs were derived for the population. If none of the separate HIs exceeded 1, it was concluded that noncarcinogenic effects from exposure to site-related chemicals were unlikely.

3.1.4.3 *Evaluating the Hazards Associated with Exposure to Lead*

The USEPA has developed the Integrated Exposure Uptake Biokinetic (IEUBK) model to evaluate lead exposure in children. The model estimates blood lead levels resulting from all applicable routes of exposure. The agency has set a target blood lead level of 10 μg Pb/dL blood, which will be used in evaluating child lead exposures in the RA.

The agency recognizes that this approach is not appropriate for land use best described by non-residential adult exposure (USEPA 1994d). The agency has recommended a short-term option based on a simple approach that approximates the more complicated biokinetics in humans. Models for adult exposure are available in the scientific literature that meet USEPA's short-term criterion. Exposures and acceptable residual soil levels were estimated using the model developed by Bowers and colleagues (1994) as modified by USEPA Region VIII in the risk assessment for the California Gulch Superfund site (USEPA 1995b). Target blood lead level ranges for the adult working population in the regulatory literature vary. In the California Gulch Superfund site risk assessment, a target level of 11.1 μg Pb/dL blood for women of child-bearing age is proposed. This level represents the 95th percentile value of the distribution and is based on the child target level of 10 μg Pb/dL blood and a mean ratio of fetal blood lead to maternal blood lead of 0.90 (Goyer 1990). This value of 11.1 μg Pb/dL blood was used in this assessment to develop a geometric mean value (see Appendix O) for evaluation of lead exposure to adults.

3.1.5 Uncertainty Analysis

Preparing a baseline risk assessment for any site necessitates that numerous assumptions be made. As the baseline risk assessment is being prepared, technical issues arise, such as data selection, formulation of assumptions, and selection of appropriate exposure scenarios and modeling efforts. As a result, differences in risk estimates result from uncertainty and variability associated with the assumptions made and data input values used. Reporting single-value estimates of risk may be misleading, because single-value estimates tend to give the impression that estimated risks are known precisely. Health risk assessments should not only characterize the potential risks to human health, they should also express risk estimates in such a way that the assumptions made to derive those estimates and the uncertainties associated with such estimates are evident to the decision maker.

3.1.5.1 *Chemicals of Potential Concern*

Uncertainties associated with the collection of samples and subsequent laboratory analysis may affect the results of the COPC selection process. These uncertainties result from possible

contamination during collection, preparation, and analysis, along with instrument error (see Section 2.5).

3.1.5.2 *Estimates of Exposure Point Concentrations*

EPCs are single-point estimates that are not based on spatial distribution of chemicals. Exposure concentrations for soil (and, therefore, vegetables) assume no removal processes such as wind erosion, runoff, or leaching. Future-use scenarios do consider organic chemical degradation in soil based on environmental half-lives. Nonetheless, EPCs are assumed to be constant over the exposure period, which in some cases is as long as 30 years.

3.1.5.3 *Exposure Assessment*

Varying degrees of uncertainty are associated with the many assumptions used for the exposure assessment. These uncertainties are offset by using assumptions that tend to bias the assessment in the direction of overestimating the total exposure. As shown in Table 3-5, the assumptions used, on the whole, tended to overestimate potential exposure.

Table 3-5. Assumptions Used for Exposure Assessment

	Relative Magnitude of Overestimate or Underestimate of Average Exposure		
Assumption	**Overestimation**	**Underestimation**	**Over or Underestimation**
Exposure Parameter Estimation	Large		
Exposure concentrations in air assume exposure or media uptake at the on- or off-site maximum.	Large		
Intake rates are assumed to be constant over the exposure duration.	Moderate		
Assumptions regarding body weight, life expectancy and lifestyle are generalized and may not be representative of any actual exposure situation.			Moderate

Note.—A designation of "moderate" indicates that estimates of exposure may be affected by 1 to 2 orders of magnitude, while assumptions marked "high" may affect estimates of exposure by more than 2 orders of magnitude.

3.1.5.4 *Incremental Lifetime Cancer Risks and Cancer Slope Factors*

The USEPA has derived CSFs using a weight-of-evidence approach to studies in the scientific

literature. The CSFs represent the upper 95th percentile confidence limits on the slope of the dose-response curve for carcinogenic responses. Because of the lack of human epidemiological data for most chemicals, the evidence results are derived from animal studies in which experimental groups were exposed for most of their lifetime to doses many times those normally found in the environment.

The USEPA uses a prescribed protocol to evaluate animal data for estimating human cancer potency factors. The model utilized is the linearized multistage extrapolation model, which provides a mathematical approximation of the dose-response slopes. This model is more likely to overestimate the actual risk rather than underestimate it. Because the models do not incorporate the role of biological protective mechanisms or human epidemiology, they are only gross indicators that are specifically designed to overestimate potential risks. Some work has been done to attempt to quantify the uncertainty involved in this type of risk characterization; however, at present, uncertainty analyses remain primarily qualitative. The linearized multistage model is currently viewed as extremely conservative for those chemicals thought to be promoters rather than initiators of carcinogenesis.

Initiators of carcinogenesis are thought to act through irreversible genetic damage. Such damage is thought to accumulate throughout life. A graph of probability of cancer versus dose would then go through the origin—the point where zero dose gives rise to zero probability. This is the definition of a "non-threshold" effect. According to this theory, a small but finite probability is said to exist that even the smallest dose of carcinogen on just one occasion might be adequate to cause cancer in the exposed individual. The linearized multistage model, which is based on the premise that all carcinogens are initiators, has been in use since 1976 to estimate the probability of cancer at very low doses of initiator chemicals.

Promoters of carcinogenesis cannot produce a cancer unless an initiator has already acted upon a cell to transform it from the normal state into an initiated but precancerous state. Promoters then act by reversible mechanisms to increase the probability that a population of initiated cells will give rise to a demonstrable cancer. Also, promoters need to be present continuously or at regular intervals for a long period to exert their effect. In this case, a graph of probability of cancer versus dose of promoter would not pass through the origin. Instead, the probability of cancer would fall to zero for some range of low doses. The dose at which the probability becomes greater than zero then becomes the "threshold" dose, which is the definition of a "threshold" effect. This definition implies that several sets of conditions can exist in which a low dose of promoter does not cause cancer.

3.1.5.5 *Systemic Health Effects*

Uncertainties also arise in the development of the RfDs used to characterize systemic effects. These reference values are derived using studies in humans or animals by identifying the no-observed-adverse-effect-level (NOAEL) or the lowest-observed-adverse-effect-level (LOAEL). Two basic types of uncertainty arise. The first is related to the extrapolation from toxic effects seen at high doses to predict effects at the low doses usually encountered in the environment.

The second involves extrapolation from effects seen in animals to effects in man. Each of these is offset by an uncertainty factor which is actually a product of as many as five separate factors, each intended to account for one type of uncertainty (USEPA 1989a). The LOAEL or NOAEL is then divided by this composite uncertainty factor. In general, a factor of 10 is allowed for each of the five types of uncertainty, but USEPA (1989a) recommends that the uncertainty factor not be allowed to exceed 10,000. The five types of uncertainty are as follows:

1. Human to Sensitive Human—A 10-fold factor is used when extrapolating from valid experimental results using prolonged exposure to average healthy humans. This is intended to account for variations in sensitivity among members of the human population.

2. Animal to Human—An additional 10-fold factor is used when extrapolating from valid results of long-term studies on experimental animals when results of human studies are not available or are inadequate. This factor accounts for the possibility that humans could be more sensitive than the animal species tested.

3. Short-term Study to Long-term Study—An additional factor of up to 10 is used when extrapolating from results of animal studies that were of less than chronic duration or when no useful data are available from long-term human studies. Chronic animal studies usually involve exposures of 1 year or longer. This factor is intended to account for the uncertainty of failure to detect chronic toxic effects in subchronic studies.

4. LOAEL to NOAEL—An additional factor of up to 10 is used when deriving a reference value from a LOAEL instead of a NOAEL. The magnitude of the factor is dependent on knowledge of the slope or shape of the dose-effect relationship.

5. Incomplete to Complete Database—An additional factor of up to 10 may be used, depending on the number and types of toxicity that have been sought in the available studies.

3.1.5.6 *Risk Characterization*

Generally, additivity is assumed for all carcinogens and for systemic toxicants with similar endpoints. Information on the interaction of chemicals in mixtures is limited. Synergistic or greater than additive (e.g., multiplicative) interactions are known to exist for environmental toxicants. Additive models would underestimate these types of interactions. Antagonistic relationships between chemicals also exist; these interactions are overestimated using an additive model.

3.1.6 Conclusions and Recommendations

The results of the RA are summarized and conclusions from the assessment developed in the context of the uncertainties inherent in the process. Perspective has been provided for the upper bound and central tendency estimates presented in the assessment to provide input into the risk management decision-making process relating to potential cleanup of individual SWMUs.

3.2 ECOLOGICAL ASSESSMENT

A quantitative ecological risk assessment for all the SWMUs listed in Table 3-1 will be addressed in the *TEAD-N Final Site-Wide Ecological Risk Assessment Report* (Rust E&I 1996). This assessment document was submitted in October 1996. Ecological risks for each SWMU are evaluated separately under the SWERA, and conclusions from the SWERA will be merged with conclusions from this RI Addendum Report during the FS to determine final remedial action alternatives. The assessment for these SWMUs will include a discussion of the general ecology and habitat of each SWMU, surveys of vegetation and wildlife present, and a quantitative evaluation of potential adverse effects to biota using the HQ/HI exposure pathway approach. Where COPCs that have the ability to bioaccumulate/biomagnify are present, a model was used to predict COPC transfer through the food chain. The surveys and field work for the 11 SWMUs in OUs 4, 8, and 9 did not include collection of vegetation, wildlife, or co-located soils for sampling purposes. Soil concentrations used for the ecological risk assessment at these SWMUs are based on the Cterm (95% upper confidence level (UCL)) derived from existing COPC soils data from Phase I and Phase II RI sampling. A list of the COPCs at each SWMU, along with the vegetation and wildlife present, are identified in tables and will be included in the *TEAD-N Final Site-Wide Ecological Risk Assessment Report*.

4.0 OPERABLE UNIT 4

OU 4 consists of three sites in the eastern part of TEAD: the Former Transformer Boxing Area (SWMU 31), the PCB Spill Site (SWMU 32), and the Wastewater Spreading Area (SWMU 35). SWMU 31 is an open storage lot, used from about 1979 to 1980 for the temporary storage of transformers. SWMU 32 is the location of a previous transformer oil spill. SWMU 35, where wastewater from an on-site housing area was allowed to discharge, contains two unlined ditches leading to a ravine and a spreading area. This section presents the previous investigations and Phase I and Phase II RI results for the three SWMUs in this OU.

4.1 FORMER TRANSFORMER BOXING AREA (SWMU 31)

4.1.1 Site Characteristics

The Former Transformer Boxing Area (SWMU 31) is located on Open Storage Lot 680 (Figure 4-1). Lot 680 is a flat, gravel-covered area, measuring 625 feet by 300 feet and is located within the industrial BRAC parcel. This area is located approximately 1,600 feet east of the PCB Spill Site (SWMU 32). Lot 680 was used from 1979 to 1980 for the temporary storage of transformers that were once stored at the Former Transformer Storage Area (SWMU 17). No leaks or spills were reported to have occurred during the short-term storage of the transformers at SWMU 31. From Lot 680, the transformers were sent for off-site disposal or were transferred to Building 659 (SWMU 33). During the Phase II RI field investigation, this site was being used for vehicle storage. This SWMU is within the BRAC parcel, and vehicles and equipment stored on the open lot have since been sold or transferred to the Red River Army Depot, Texas.

4.1.2 Previous Investigations and Phase II RI Activities

No environmental samples had been collected at this site prior to the Phase II RI field investigation. No surface soil staining was detected during a review of historical aerial photographs (CNES 1992); however, the storage area was resurfaced periodically with gravel, potentially covering any staining that may be associated with spills. Site walkovers during the Phase I RI field activities also failed to identify any areas of surface staining or other evidence that would indicate that a spill or leak had occurred. Although there were no data that indicated that a release of PCBs had occurred at SWMU 31, PCBs have been found at SWMU 17, the Former Transformer Storage Area, where the transformers were stored prior to being transported to SWMU 31. This suggested that similar spills of PCB-contaminated oil may have also occurred at SWMU 31.

To address the possibility that spills or releases may have occurred, a 75-by-125-foot grid pattern was established over Lot 680. Surface soil samples (0 to 6 inches) were collected from the center of each of the 21 rectangular areas during the Phase II RI field investigation (see

Figure 4-1). Samples were analyzed for PCBs. In addition, one-third of these samples (for a total of seven) were also analyzed for metals, SVOCs, and VOCs to address the possibility of the presence of other types of contamination.

4.1.3 Contamination Assessment

4.1.3.1 *Data Evaluation*

This section evaluates the analytical data for its usability in the risk assessment. A data evaluation was performed by reviewing the data quality codes assigned by the USAEC Chemistry Branch and EcoChem, an independent third-party validator. In an effort to ascertain the level of certainty/uncertainty, USEPA data qualifiers were then assigned as an aid in interpreting the data for use in the risk assessment. (Table 2-4 defines the relationship between the USAEC Chemistry Branch codes and USEPA data qualifiers.) The following sections summarize the results of this process.

4.1.3.1.1 ***Field Duplicates*.** The "D" flag code represents a field duplicate. All "D" flagged data were compared with the primary investigative result, and the higher of the two values was used in the quantitative risk assessment.

4.1.3.1.2 ***Blank Assessment*.** The USEPA has determined that, when blank contamination exists, the investigative results must exceed the blank result by a factor of 5 (all compounds) or 10 (common laboratory contaminants such as acetone) in order to be considered positive. Several metals were detected in method blanks and/or other blanks associated with SWMU 31 soil samples. Based on comparisons to blanks, positive metals results in surface soil were changed to nondetects for the following samples:

- Iron—TBS-94-03 and -06
- Vanadium—TBS-94-03, -06, -09 (and duplicate), -15, -19, and -21

Per USEPA guidance (USEPA 1989), the associated blank concentration was considered the quantitation limit for the affected samples.

4.1.3.1.3 ***USAEC Chemistry Branch Validation*.** The USAEC Chemistry Branch reviewed the analytical data for technical deficiencies based on the *USATHAMA (USAEC) Quality Assurance Program (PAM 11-41)*. USAEC data quality codes assigned by the Chemistry Branch would be an indication of QC recoveries outside of USAEC control limits and other technical deficiencies. Estimating or rejecting the data for use in the risk assessment based on USAEC codes is judged to be conservative, since USAEC control limits are generally narrower than USEPA Functional Guidelines. For SWMU 31, all data were accepted for use without qualification.

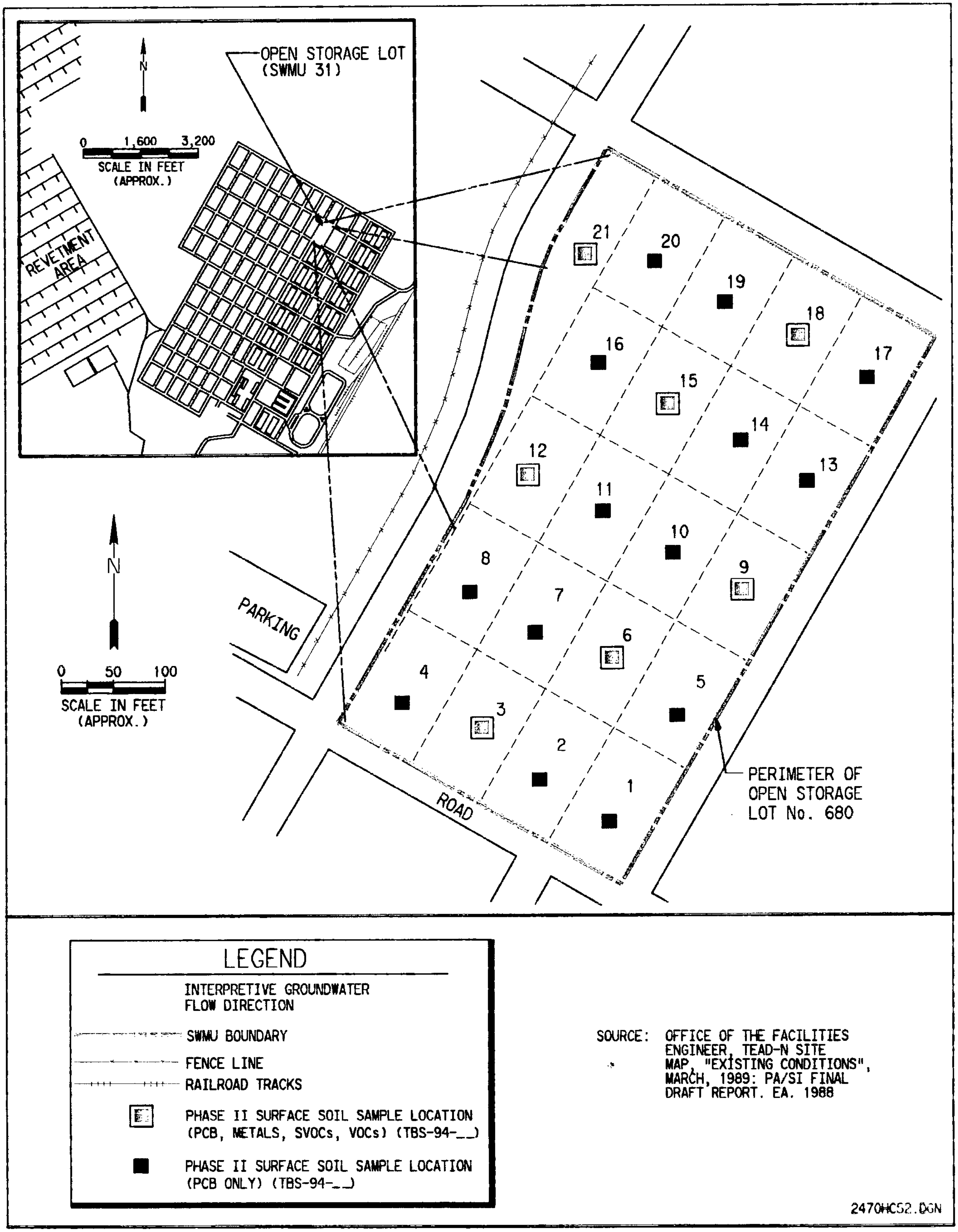


Figure 4-1. Location Map and Phase II Sample Locations for SWMU 31

Non-Certified Compounds. USAEC flag codes of R or T were assigned by the analytical laboratory to indicate non-detected compounds that had not been performance demonstrated or validated under the USAEC's 1990 QA program. Under this program a distinction is made between "target" and "non-target" analytes. "Target" compounds are determined during the certification process, and CRLs for these analytes are established. "Non-target" compounds are those that were added to the method to meet project-specific requirements, and the lowest calibration standard used for that analyte typically reflects the "practical quantitation level." Many of the "non-target" compounds initially flagged R or T were subsequently certified under the USAEC's QA program and are not flagged as such in later analyses. As a conservative approach for the purpose of the risk assessment, quantitation limits for R or T flagged compounds will be assigned a J-code, due to any uncertainty associated with not having undergone a rigorous certification process.

4.1.3.1.4 ***Independent Third-Party Data Validation.*** A data quality assessment was completed using a validation effort by EcoChem, an independent third party. EcoChem's review and recommendations were based on USEPA Functional Guidelines as well as the *USATHAMA (USAEC) Quality Assurance Program (PAM 11-41)* and individual methods. All USEPA data qualifiers recommended by EcoChem were incorporated for use in the risk assessment and are provided in the analytical summary tables of Appendix J.

For SWMU 31, EcoChem evaluated one lot of inductively coupled plasma (ICP)-metal analyses of soil samples by Method JS12 and one lot of SVOC analyses of soil samples by Method LM25.

For the ICP-metals analyses, Lot ANUC, EcoChem rejected all antimony detection limits due to 0 percent recovery in the MS/MSD. The USAEC did not flag this problem because natural spikes are not part of the USAEC QA program.

For the semivolatile data, Lot ANFR, EcoChem recommended hexachlorocyclopentadiene results (all non-detects) qualified as estimated due to decreased sensitivity during continuing calibration. Toxaphene and three PCB aroclors (PCB 1016, 1260, and 1262), reported as less than values on the transfer files, were rejected by EcoChem as having only been scanned for as unknowns.

Listed below are the sample results rejected for use in the risk assessment:

- Surface Samples
  –Antimony - TBS-94-03,-06,-09 and dup, -12, -15,-18,-21
  –Toxaphene - TBS-94-03,-06,-09 and dup, -12, -15,-18,-21
  –PCB 1016 - TBS-94-03,-06,-09 and dup, -12, -15,-18,-21
  –PCB 1260 - TBS-94-03,-06,-09 and dup, -12, -15,-18,-21
  –PCB 1262 - TBS-94-03,-06,-09 and dup, -12, -15,-18,-21

4.1.3.1.5 ***Data Evaluation Summary.*** A total of 21 surface soil samples (and 1 duplicate) were collected in 1994 from 21 surface locations at SWMU 31. All samples were analyzed for PCBs. Seven samples were also analyzed for volatiles, semivolatiles, and metals.

Because of blank contamination, positive results for iron and vanadium were changed to nondetects in a few samples. The detected values in the affected samples were below background screening levels for the metals, indicating that this issue does not significantly impact the risk assessment results.

Antimony and thallium were not detected in any soil samples. The antimony and thallium reporting limits exceed the background screening values (15 μg/g and 11.7 μg/g, respectively) for these metals. Additionally, all antimony nondetect results were rejected due to poor matrix spike recoveries. However, the current land use PRGs calculated by Dames and Moore (1996) (136 to 467 μg/g for antimony and 98.1 to 1,330 μg/g for thallium) are significantly higher than the above-mentioned reporting limits. Therefore, no data gap exists under current land use conditions. However, additional sampling may be necessary prior to any future residential land use.

Reporting limits for cadmium (1.2 μg/g) and silver (0.80 μg/g) were above their respective background screening values but less than their respective ingestion and soil-to-air RBCs. Therefore, this issue does not significantly impact the risk assessment results.

Nondetect results for each of the following semivolatiles were rejected because the compounds were not included in the initial and continuing calibration standard: PCB 1016, PCB 1260, PCB 1262, and toxaphene. No PCBs were detected using a methodology specifically for detecting these compounds. Additionally, toxaphene has not been reported at other SWMUs and, based on its history, would not be expected to be detected in soils at this SWMU. Therefore, this issue does not significantly impact the risk assessment results for these chemicals.

Approximately 95 percent of sample results were judged to be usable for risk assessment purposes. The number of samples and the analytical parameter list appear to be sufficient to characterize the nature, extent, and potential magnitude of contamination at this SWMU with exceptions noted above. A summary of chemicals detected in at least one surface or subsurface soil sample at SWMU 31 is presented in Appendix J, including corresponding data qualifiers (where applicable) based on USEPA functional guidelines.

4.1.3.1.6 ***Background Screening.*** The maximum concentrations of inorganic chemicals detected in soil at SWMU 31 were compared to the site-specific background screening values (see Section 2.6). Any inorganic chemical detected in at least one sample at a concentration higher than the background screening value was retained in the COPC database. Surface soil and subsurface soil were screened separately. The results of the background screening are shown in Table 4-1. Based on this screening analysis, lead and sodium are the only inorganic analytes considered preliminary COPCs at SWMU 31. Although cadmium, silver, and thallium were not detected in surface soil at this site, the CRLs for these metals were higher than their respective background screening values.

Table 4-1. Background Screening of Inorganic Chemicals Detected in Soil at SWMU 31

Chemical	Frequency of Detection[a]	Maximum Detected Value ($\mu g/g$)[b]	Site-specific Background Screening Value[c] ($\mu g/g$)	Exceeds Site-specific Background?
Surface Soil				
Aluminum	7/7	11,600	28,083	No
Arsenic	7/7	10.4	11.69	No
Barium	7/7	104	247	No
Calcium	7/7	78,000	114,483	No
Chromium	7/7	17.7	20.62	No
Cobalt	4/7	3.58	6.94	No
Copper	7/7	15.3	24.72	No
Iron	5/7	10,500	22,731	No
Lead	7/7	40.4	18.23	**YES**
Magnesium	7/7	6,100	7,062	No
Manganese	7/7	238	698	No
Nickel	7/7	7.02	17.40	No
Potassium	7/7	3,250	5,450	No
Sodium	7/7	369	337	**YES**
Vanadium	1/7	18.1	28.39	No
Zinc	7/7	72.7	102.8	No

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]Micrograms per gram.
[c]See Section 2.6.1.1 for an explanation of how the site-specific background screening values were calculated.

4.1.3.2 *Summary of Analytical Results*

The Phase II sample results are shown in Figure 4-2, and the list of analytes (detected in at least one surface or subsurface soil sample) is provided in Table 4-2 for Phase II data. The complete data set is contained in Appendix H.

4.1.3.3 *Nature and Extent of Contamination*

The initial focus of the investigation was on the potential for the transformers previously stored at this lot to have contaminated the soils with PCBs. RI activities included the collection and analysis of 21 surface-soil samples. All samples were analyzed for PCBs, and seven samples were also analyzed for VOCs, SVOCs, and metals. No PCBs were detected in any of the 21 surface-soil samples analyzed for PCBs. From the seven samples that were also analyzed for VOCs, SVOCs, and metals, no VOCs were detected. Six of the seven samples contained low concentrations of SVOCs, with the highest concentration of 1.8 μg/g in sample TBS-94-09 (Figure 4-2). Lead, detected in all seven samples, was the only metal detected above background concentrations, ranging from 25.4 μg/g to 40.4 μg/g.

The following SVOCs were detected in surface sample TBS-94-03: benzo[*a*]anthracene (0.27 μg/g), benzo[*b*]fluoranthene (0.62 μg/g), chrysene (0.39 μg/g), fluoranthene (0.36 μg/g), phenanthrene (0.34 μg/g), and pyrene (0.56 μg/g)(Table 4-1). Bis(2-ethylhexyl) phthalate, benzo[*a*]anthracene, chrysene, fluoranthene, phenanthrene, and pyrene were detected in low concentrations in samples TBS-94-06 and TBS-94-09, with 1.8 μg/g of bis(2-ethylhexyl)phthalate as the highest concentration. TBS-94-12 contained only low levels of chrysene (0.059 μg/g) and fluoranthene (0.043 μg/g). Low concentrations of benzo[*a*]anthracene (0.11 μg/g), chrysene (0.14 μg/g), fluoranthene (0.14 μg/g), phenanthrene (0.14 μg/g), and pyrene (0.19 μg/g) were found in surface sample TBS-94-15. Chrysene (0.09 μg/g), fluoranthene (0.067 μg/g), and phenanthrene (0.075 μg/g) were detected in TBS-94-21.

In summary, no PCB or VOC contamination was detected at SWMU 31. This lot was being used for vehicle storage during the Phase II RI field investigation, and it is likely that the SVOCs detected are associated with leakage of fluids from the vehicles that were stored on site. Low concentrations of SVOCs were detected at locations spread out over the entire lot (Figure 4-2). The horizontal extent of contamination may be limited to Lot 680 or the areas where the vehicles were stored. Lead was detected in all seven of the samples. The source of the lead contamination is unknown. The vehicles have since been removed from Open Storage Lot 680, thereby removing the suspected source of SVOCs at SWMU 31.

4.1.4 Human Health Risk Assessment

As part of the Phase II RI, an RA was conducted to estimate potential human health risks associated with the no-action alternative for SWMU 31, the Former Transformer Boxing Area.

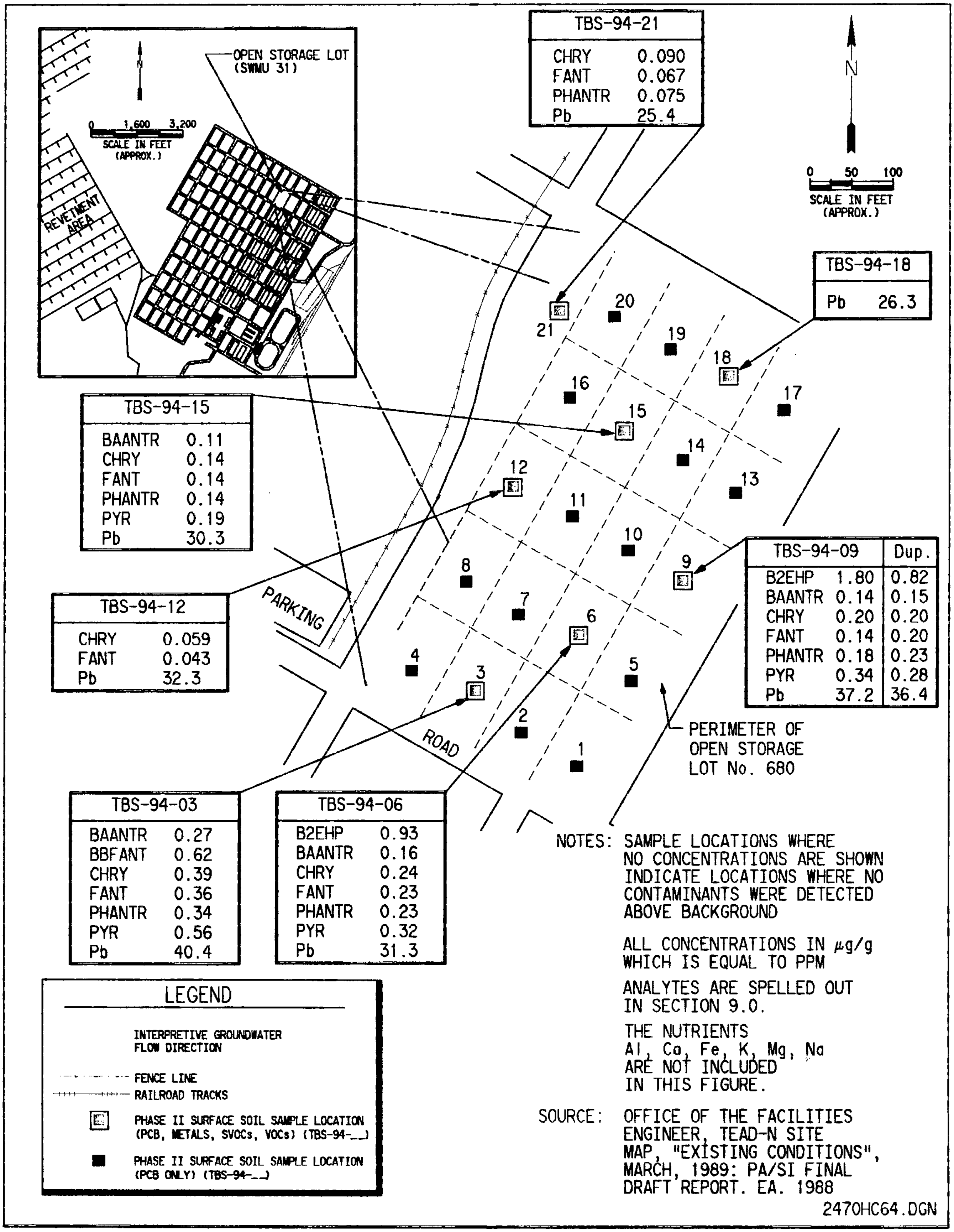


Figure 4-2. SWMU 31 Phase II Sample Results

Table 4-2. Summary of Analytes Detected in Soil for the Former Transformer Boxing Area (SWMU 31) - Phase II

Group	Analytes	Background Concentrations	TBS-94-01 (0.5ft)	TBS-94-02 (0.5ft)	TBS-94-03 (0.5ft)	TBS-94-04 (0.5ft)	TBS-94-05 (0.5ft)	TBS-94-06 (0.5ft)	TBS-94-07 (0.5ft)	TBS-94-08 (0.5ft)	TBS-94-09 (0.5ft)	TBS-94-09(D) (0.5ft)	TBS-94-10 (0.5ft)
METALS	ALUMINUM	28083	NT	NT	6640	NT	NT	6870	NT	NT	8250	8290	NT
	ARSENIC	11.69	NT	NT	10.2	NT	NT	7.57	NT	NT	8.99	9.74	NT
	BARIUM	247.1	NT	NT	65.4	NT	NT	69.4	NT	NT	83.8	82.2	NT
	CALCIUM	114483	NT	NT	49400	NT	NT	76000	NT	NT	48300	49900	NT
	CHROMIUM	20.62	NT	NT	14.1	NT	NT	11.7	NT	NT	15.7	15.1	NT
	COBALT	6.94	NT	NT	2.74	NT	NT	LT 2.5	NT	NT	3.29	2.99	NT
	COPPER	24.72	NT	NT	11.9	NT	NT	9.26	NT	NT	14.4	14.5	NT
	IRON	22731	NT	NT	6780#	NT	NT	5900#	NT	NT	8600	7970	NT
	LEAD	19.23	NT	NT	44.4*	NT	NT	31.3*	NT	NT	37.2*	36.4*	NT
	MAGNESIUM	7061	NT	NT	5280	NT	NT	6440	NT	NT	5910	6400	NT
	MANGANESE	698.3	NT	NT	149	NT	NT	131	NT	NT	186	193	NT
	NICKEL	17.4	NT	NT	5.13	NT	NT	4.14	NT	NT	7.02	6.23	NT
	POTASSIUM	5449	NT	NT	1760	NT	NT	1490	NT	NT	2180	2270	NT
	SODIUM	337	NT	NT	284	NT	NT	284	NT	NT	349*	317	NT
	VANADIUM	28.39	NT	NT	12.1#	NT	NT	10.7#	NT	NT	13.7#	13.5#	NT
	ZINC	102.8	NT	NT	52.6	NT	NT	41.2	NT	NT	62.5	62.8	NT
SEMIVOLATILES	BENZO (A) ANTHRACENE	N/A	NT	NT	0.27*	NT	NT	0.16*	NT	NT	0.14*	0.15*	NT
	BENZO (B) FLUORANTHENE	N/A	NT	NT	0.62*	NT	NT	LT 0.31	NT	NT	LT 0.31	LT 0.31	NT
	BIS (2-ETHYHEXYL) PHTHALATE	N/A	NT	NT	LT 0.48	NT	NT	0.93*	NT	NT	1.9*	0.82*	NT
	CHRYSENE	N/A	NT	NT	0.39*	NT	NT	0.24*	NT	NT	0.2*	0.2*	NT
	FLUORANTHENE	N/A	NT	NT	0.36*	NT	NT	0.23*	NT	NT	0.14*	0.2*	NT
	PHENANTHRENE	N/A	NT	NT	0.34*	NT	NT	0.23*	NT	NT	0.18*	0.23*	NT
	PYRENE	N/A	NT	NT	0.56*	NT	NT	0.32*	NT	NT	0.34*	0.28*	NT

Group	Analytes	Background Concentrations	TBS-94-11 (0.5ft)	TBS-94-12 (0.5ft)	TBS-94-13 (0.5ft)	TBS-94-14 (0.5ft)	TBS-94-15 (0.5ft)	TBS-94-16 (0.5ft)	TBS-94-17 (0.5ft)	TBS-94-18 (0.5ft)	TBS-94-19 (0.5ft)	TBS-94-20 (0.5ft)	TBS-94-21 (0.5ft)
METALS	ALUMINUM	28083	NT	11600	NT	NT	7170	NT	NT	8360	NT	NT	7120
	ARSENIC	11.69	NT	10.4	NT	NT	8.98	NT	NT	8.41	NT	NT	9.07
	BARIUM	247.1	NT	104	NT	NT	71.8	NT	NT	83.5	NT	NT	74.1
	CALCIUM	114483	NT	45300	NT	NT	47600	NT	NT	67000	NT	NT	78000
	CHROMIUM	20.62	NT	17.7	NT	NT	14.2	NT	NT	14	NT	NT	16.1
	COBALT	6.94	NT	3.58	NT	NT	LT 2.5	NT	NT	2.81	NT	NT	LT 2.5
	COPPER	24.72	NT	15.3	NT	NT	11.1	NT	NT	13	NT	NT	13.2
	IRON	22731	NT	10500	NT	NT	7530	NT	NT	8140	NT	NT	8310
	LEAD	19.23	NT	32.3*	NT	NT	30.3*	NT	NT	24.3*	NT	NT	25.4*
	MAGNESIUM	7061	NT	6100	NT	NT	5740	NT	NT	5240	NT	NT	5720
	MANGANESE	698.3	NT	238	NT	NT	161	NT	NT	193	NT	NT	177
	NICKEL	17.4	NT	8.56	NT	NT	5.07	NT	NT	6.37	NT	NT	6.68
	POTASSIUM	5449	NT	3260	NT	NT	1980	NT	NT	2200	NT	NT	1850
	SODIUM	337	NT	354*	NT	NT	308	NT	NT	327	NT	NT	260
	VANADIUM	28.39	NT	18.1	NT	NT	12.3#	NT	NT	13.2#	NT	NT	13.8#
	ZINC	102.8	NT	57.8	NT	NT	51.4	NT	NT	72.7	NT	NT	45.7
SEMIVOLATILES	BENZO (A) ANTHRACENE	N/A	NT	LT 0.041	NT	NT	0.11*	NT	NT	LT 0.041	NT	NT	LT 0.041
	BENZO (B) FLUORANTHENE	N/A	NT	LT 0.31	NT	NT	LT 0.31	NT	NT	LT 0.31	NT	NT	LT 0.31
	BIS (2-ETHYHEXYL) PHTHALATE	N/A	NT	LT 0.48	NT	NT	LT 0.48	NT	NT	LT 0.48	NT	NT	LT 0.48
	CHRYSENE	N/A	NT	0.059*	NT	NT	0.14*	NT	NT	LT 0.032	NT	NT	0.09*
	FLUORANTHENE	N/A	NT	0.043*	NT	NT	0.14*	NT	NT	LT 0.032	NT	NT	0.067*
	PHENANTHRENE	N/A	NT	LT 0.032	NT	NT	0.14*	NT	NT	LT 0.032	NT	NT	0.075*
	PYRENE	N/A	NT	LT 0.083	NT	NT	0.19*	NT	NT	LT 0.083	NT	NT	LT 0.083

Note.- All values in μg/g (equal to ppm).
N/A - Not Applicable.
NT - Not Tested.
- Analyte was detected in the associated blank in excess of the 5 or 10 times rule (as described in Section 3.1.1.1).
* - Organic analyte detected above CRL or MDL or detected inorganic analyte exceeding background.
LT - Analyte concentration is less than CRL, the CRL is posted next to the "LT".
(D) - Duplicate analysis.

The following tasks were completed in the RA:

- Data analysis and identification of COPCs
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Summary and conclusions

This section provides a summary of the quantitative risk assessment process used at SWMU 31 and the results of that process. The RA for SWMU 31 is based on the methodology described in Section 3.1 and supported by Appendices L, M, N, and O.

4.1.4.1 *Selection of the Chemicals of Potential Concern—Soil*

As detailed in USEPA Region III guidance, a screening procedure can be used to narrow the list of contaminants at a particular site to a subset of analytes that can be considered COPCs for the area. This screening procedure can involve up to four steps, depending on the contaminants present:

- Group data by chemical class (e.g., carcinogenic PAHs)
- Evaluate frequency of detection
- Evaluate essential nutrients
- Compare site data to risk-based screening concentrations (Region III values)

Below is the screening analysis for SWMU 31.

4.1.4.1.1 ***Data Grouping.*** For the purposes of the risk assessment, a benzo(a)pyrene (B[a]P)-equivalent concentration of carcinogenic PAHs (c-PAHs) was calculated for each sample. The concentration of each c-PAH detected within a sample was multiplied by its c-PAH-specific toxicity equivalency factor (TEF) to express the concentration in terms of B(a)P equivalents. The B(a)P equivalents were then summed to arrive at a total B(a)P-equivalent concentration for the sample. The c-PAHs and their associated TEFs are as follows:

- Benzo[a]pyrene: 1.0
- Benzo[b]fluoranthene: 0.1
- Chyrsene: 0.001
- Benzo[a]anthracene: 0.1
- Benzo[k]fluoranthene: 0.01
- Dibenzo[a,h]anthracene: 1.0
- Indeno[1,2,3-cd]pyrene: 0.1

4.1.4.1.2 ***Frequency of Detection.*** No evaluation of detection frequency was undertaken at this SWMU due to the small sample size.

4.1.4.1.3 ***Nutrient Screening.*** Sodium was the only nutrient chemical detected above background in surface soil. Since the maximum concentration of sodium (369 μg/g) was less

than the nutrient screening value for this chemical (1,000,000 μg/g; see Section 3.1.1.2), sodium was eliminated as a COPC in surface soil.

4.1.4.1.4 ***Region III RBC Screening.*** The final step in the COPC selection process consisted of comparing the EPCs for remaining contaminants in surface and subsurface soil with USEPA Region III RBCs. However, before these comparisons were made, a "hot spot" analysis was conducted.

Hot Spot Analysis. For the final selection of COPCs, the site was evaluated for possible "hot spots." Potential COPCs at this site were limited to lead and a few SVOCs. A review of Figure 4-2 revealed that contamination was fairly evenly distributed throughout the seven samples analyzed for these parameters. Therefore, the analytical results for all seven samples were combined for the calculation of EPCs. Table 4-3 provides a summary of the EPCs for preliminary COPCs in surface soil at SWMU 31.

Soil-related Exposure Pathways. To select COPCs for the soil-related exposure pathways, the EPCs for SWMU 31 in surface soil were compared to Region III soil ingestion and soil-to-air RBCs. As shown in Table 4-4, total carcinogenic PAHs were selected as the only COPC for this SWMU in surface soil.

4.1.4.2 *Selection of Chemicals of Potential Concern-Air*

For all receptors with the exception of the construction worker, the air pathway (i.e., inhalation of particulates) is evaluated on a SWMU-wide basis rather than by area of concern. Because all COPCs in soils were either metals or semi-volatile organics with very low volatility, potential exposures to wind-blown particulate would be contributed to by the entire SWMU (as well as exposed soil outside the defined SWMU), regardless of the specific SWMU-related activity. This was also assumed for potential off-site receptors. Air emissions of SWMU-related chemicals were assumed to occur by entrainment from wind erosion of particulate-bound COPCs. With entrainment, it is assumed that small amounts of the organic compounds or heavy metals become airborne and adsorbed onto the surface of dust particles.

A volatilization emission analysis was performed (SEC Donahue 1992b) using a volatilization release estimation equation designed for chemicals spilled or incorporated into soils (USEPA 1988a). Results from this analysis indicated negligible air quality impacts derived from volatilization releases from SWMUs located at TEAD. In addition, results from previous modeling conducted for adjacent sites with similar VOC concentrations revealed insignificant releases (SEC Donahue 1992b).

For current and future on-site receptors, COPCs retained for the soil pathways were used to evaluate exposures from air. For current off-site receptors, exposure point concentrations generated for COPCs retained for the on-site soil pathways were modeled using SCREEN2 to estimate the air quality impacts at selected sites surrounding TEAD. To maintain a health-protective approach, the RME EPC for children was used as the input soil concentration to the

Table 4-3. Summary of Preliminary Chemicals of Potential Concern (SWMU 31)

Chemical	Frequency of Detection[a]	Range of Detected Values ($\mu g/g$)[b]	Range of Reporting Limits ($\mu g/g$)	Arithmetic Mean Concentration ($\mu g/g$)	95% UCL[c] Concentration ($\mu g/g$)	Exposure Point Concentration[d] ($\mu g/g$)
Surface Soil						
Lead	7/7	25.4 - 40.4	NA[e]	31.8	36.7	36.7
Bis(2-ethylhexyl)phthalate	2/7	0.930 - 1.80	0.48	0.523	1.80	1.80
Fluoranthene	6/7	0.043 - 0.36	0.03	0.164	1.07	0.36
Phenanthrene	5/7	0.075 - 0.340	0.03	0.171	2.19	0.340
Pyrene	4/7	0.190 - 0.560	0.08	0.230	1.93	0.560
Total carcinogenic PAHs[f]	6/7	0.000059 - 0.0894	0.01	0.046	6,987	0.0894

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]Micrograms per gram.
[c]Upper confidence level.
[d]The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (USEPA 1989).
[e]Not applicable.
[f]Polynuclear aromatic hydrocarbons; Benzo(a)pyrene-equivalent total c-PAH concentration.

Table 4-4. Selection of Chemicals of Potential Concern for Soil-related Pathways Based on EPA Region III's Soil Screening Guidance (SWMU 31)

	EPA Region III RBC[a] Screen			
	Residential RBCs ($\mu g/g$)[b]			
Chemical	**Ingestion**	**Inhalation**	**Exposure Point Conc. ($\mu g/g$)**	**Retained as COPC[c]?**
Surface Soil				
Lead	400[d]	NA[e]	36.7	No
Bis(2-ethylhexyl)phthalate	46	210	1.80	No
Fluoranthene	310	6.8	0.36	No
Phenanthrene	230[f]	5.6[f]	0.34	No
Pyrene	230	5.6	0.56	No
Total carcinogenic PAHs[g]	0.088	11	0.0894	YES

[a]Risk-based concentrations (RBCs) were taken directly from the Region III RBC Table (USEPA 1995), except as noted in the footnotes. Values for noncarcinogens are 1/10 of the Region III RBC.

[b]Micrograms per gram.

[c]Chemicals of potential concern.

[d]OSWER recommended clean-up level for lead in residential soil (USEPA 1994).

[e] Not applicable.

[f]Values for pyrene.

[g]Polynuclear aromatic hydrocarbons; benzo(a)pyrene-equivalent total c-PAH concentration.

model. Off-site air concentrations generated by the model were screened against USEPA Region III Risk-Based Concentrations guidance to verify the negligible contribution of this pathway. SCREEN2 is a single-source, screening-level model that has algorithms to estimate air quality impacts associated with air sources. For a complete description of the SCREEN2 model and associated results, see Appendix N. As shown in Table 4-5, based on comparison to air RBC, no COPC were retained for quantitative off-site evaluation.

4.1.4.3 *Selection of Chemicals of Potential Concern—Groundwater*

The selection of COPCs for the groundwater exposure pathways consist of a two-phase modeling approach. Initially, the *maximum* concentration of each analyte detected in either surface or subsurface soil was compared to the Region III soil-to-groundwater RBC. One-tenth of the value was used for noncarcinogens. If the maximum concentration of a chemical exceeded the soil-to-groundwater RBC, the chemical was selected for vadose zone modeling (Table 4-6). The modeled break-through concentration in groundwater for these chemicals was then compared to the Region III tap water RBCs, with one-tenth of the value used for noncarcinogens. In addition, the modeled break-through time was compared to the 100-year cut-off period as described in Section 2.7.2. A chemical that reached the water table within 100 years *and* had a modeled break-through concentration that exceeded the Region III tap water RBC (one-tenth of the value for noncarcinogens) was retained for further vadose-saturated zone modeling to on- and off-site hypothetical receptors as described in section 2.7.2. For this second phase of modeling, the *average* surface and subsurface soil concentration was used to calculate the initial pore water concentration at the site. Again, the vadose-saturated zone modeling results were compared to the Region III tap water RBCs, with one-tenth for noncarcinogens. If the chemical still failed to meet the 100-year break-through criteria *and* exceeded the Region III tap water RBC, it was retained for quantitative risk assessment. As shown in Tables 4-6 and 4-7, lead was the only chemical in surface soil retained for vadose zone modeling at SWMU 31.

4.1.4.3.1 ***Vadose Zone Model Results.*** The soil screening described in the previous sections indicated that one COPC should be evaluated using the soil-vadose-zone-groundwater-screening model at SWMU 31. This COPC consisted of lead and is shown in Table 4-6. The vadose modeling set-up procedures are described in detail in Section 2.7 of this report. This section defines the site-specific parameters and presents the vadose-zone modeling results.

Table 4-5. Selection of Chemicals of Potential Concern for Off-site Air-related Pathways Based on EPA Region III's Risk-Based Concentration Screening Guidance (SWMU 31)

		EPA Region III Risk-Based Concentration[a] Screen ($\mu g/m^3$)[b]					
Chemical	RME SWMU-wide Soil Exposure Point Conc. (mg/kg)[c]	Exposure Point Conc. at Property Line	Exposure Point Conc. at Grantsville	Exposure Point Conc. at Tooele	Exposure Point Conc. at Stockton	Ambient Air RBC	Retained as off-site COPC[d]?
Total Carcinogenic PAHs[e]	0.0032	0.000000079	0.000000013	0.000000019	0.000000024	0.001	No

[a]Values for noncarcinogens are 1/10th of the Region III RBC (USEPA 1996).
[b]Micrograms per cubic meter.
[c]Milligrams per kilogram.
[d]Chemicals of potential concern.
[e]Polynuclear aromatic hydrocarbons; benzo(a)pyrene-equivalent total c-PAH concentration.

Table 4-6. Selection of COPCs for Groundwater Exposure Pathways (SWMU 31)

Chemical	Maximum Detected Value[a] ($\mu g/g$)[b]	Depth	Soil-to-GW[c] RBC[d] ($\mu g/g$)	Selected for Vadose Zone Modeling?	Reached the Water Table Within 100 Years	Model Output: Break-through Point Concentration in Groundwater (mg/L)[e]	Tap Water RBC (mg/L)	Selected as COPC[f] for Groundwater[g]?
Lead	40.4	Surface	15[h]	YES	No	---[i]	0.015[j]	No
Bis(2-ethylhexyl)phthalate	1.80	Surface	11	No	---	---	---	---
Fluoranthene	0.36	Surface	98	No	---	---	---	---
Phenanthrene	0.34	Surface	140[k]	No	---	---	---	---
Pyrene	0.560	Surface	140	No	---	---	---	---
Total carcinogenic PAHs[l]	0.0894	Surface	4	No	---	---	---	---

[a]Maximum organic analyte detected above CRL or MDL or maximum detected inorganic analyte exceeding background.
[b]Micrograms per gram.
[c]Groundwater.
[d]Risk-based concentrations (RBCs) were taken directly from the Region III RBC Table except as indicated in these footnotes.
[e]Milligrams per liter; values taken from Table 4-6.
[f]Chemicals of potential concern.
[g]Eliminated as a groundwater COPC if the chemical reached the water table in more than 100 years or did not exceed the tap water RBC.
[h]Calculated according to Region III guidance (USEPA 1995).
[i]Not applicable; not modeled or vadose zone modeling showed that the chemical breakthrough time to the water table is greater than 100 years.
[j]Action level for lead (USEPA 1995).
[k]Value for pyrene.
[l]Benzo(a)pyrene-equivalent concentration of total c-PAHs.

Table 4-7. Summary of Break-through Vadose Zone Modeling Results and Critical I/O GWM-1 and MULTIMED Parameters for SWMU 31

COPC Specific Parameters						
Analyte	Kd[a]	Tc (max)[b] (ppm)	C_{init}[c] (mg/L)	Breakthrough Time (yrs)	Breakthrough Conc. (mg/L)	p.d.[d] (yrs)
Lead	4.5	40.4	9.73	3,100	0.0016	24

Note.—Site-specific parameters are as follows: vadose zone thickness (H) = 9,906 cm; area of contaminated soil (CA) = 16,165 m²; thickness of contaminated soil (Hcont) = 30.5 cm.

[a]The distribution coefficient; it is dimensionless.

[b]The maximum observed soil concentration (ppm).

[c]The pore water concentration at the source as conservatively calculated by GWM-1.

[d]The pulse duration as calculated by GWM-1.

The SWMU 31 site-specific input parameters are defined as the thickness of the vadose zone (H cm), the area of contamination (CA m^2), and the thickness of the contaminated zone (H cont. cm). These input parameters and the COPC chemical-specific parameters are used as the input for the GWM-1 and MULTIMED models. The GWM-1 spreadsheets for SWMU 31 are shown in Appendix K. As these spreadsheets indicate, the above site-specific parameters for SWMU 31 are as follows:

H = 9,906 cm

CA = 16,165 m^2

H cont = 30.5 cm

Other key COPC-specific parameters—the distribution coefficient (Kd), the maximum observed soil concentration (Tc), the initial pore water concentration (C_{init}), and the plume pulse duration (p.d.)—are also shown in Appendix K. Table 4-7 summarizes these COPC-specific parameters and shows the MULTIMED output for COPC break-through time (time after leaching starts, that the leading edge of the COPC plume reaches the top of the water table) along with the COPC estimated concentration at the time that breakthrough occurs. One key to interpreting these estimates is that the pore water concentration was determined by starting with the maximum observed soil concentration measured at the site (see Table 4-6) and calculating the maximum concentration available for the pore water solution by soil-water partitioning. As explained in Section 2.7, the equation used is very dependent on Kd and does not take into account mineral solubility and equilibrium relationships. This is evident by some of the high C_{init} concentrations estimated for several of the COPCs.

4.1.4.3.2 ***Groundwater COPCs.*** As shown in Table 4-7, the MULTIMED output indicates that within a 100-year time period lead will not reach the water table. Table 4-7 provides the critical input and output parameters and the estimated break-through time for lead. The table

also shows the estimated concentration associated with the arrival of the leading edge of the COPC plume at the water table. Again, it should be noted that the break-through time calculation does not take into account the various retardation influences, such as biodegradation, volatilization, absorption, adsorption, and mineral-solution equilibrium relationships.

In summary, the model estimated a break-through time for lead of 3,100 years, indicating that the groundwater exposure pathway is not complete for the various scenarios evaluated for SWMU 31. Since lead did not break through to the water table within the 100-year period, it was eliminated as a potential groundwater COPC.

4.1.4.4 *Exposure Assessment*

Exposure is defined as the contact of a receptor with a chemical (USEPA 1989c). Exposure assessment is the estimation of the magnitude, frequency, and duration for each identified route of exposure. The magnitude of an exposure is determined by estimating the amount of chemical available at the receptor exchange boundaries (i.e., lungs, gastrointestinal tract, or skin) during a specified time period.

Section 3.1.2 describes the general tasks comprising the exposure assessment. The specific application of these tasks to SWMU 31 is described below.

4.1.4.4.1 ***Characterization of Exposure Setting***. The first step in developing exposure scenarios for SWMU 31 was to characterize the site setting in which potential exposures might occur. The characteristics of the site setting influence the types of transport mechanisms and the type of receptor exposure that could occur. The site setting also provides a basis for identifying the potential receptors (either real or, in the case of site redevelopment for alternative use, hypothetical). Both current land use patterns and future land use patterns were examined as part of the characterization.

Current Land Use. SWMU 31 is located in the eastern portion of TEAD within the BRAC parcel. This SWMU consists of Open Storage Lot 680, which was previously used as a parking area for vehicles. Prior to vehicle storage, this lot was used for short-term storage of transformers that had been moved from SWMU 7. Although leasing of portions of the BRAC parcel has begun, SWMU 31 remains an open lot and transient exposure by the public is expected to be minimal.

Based on the above information, potential receptors under current land use were defined as the SWMU-specific laborers and security personnel (e.g., individuals with job descriptions that call for repeated, light to moderate labor in the general vicinity of SWMU 31; staff assigned to maintenance of the perimeter; or security personnel that repeatedly work in the vicinity of SWMU 31).

Because other potential receptors would be exposed only intermittently to SWMU 31, site-specific laborers and security personnel were the only on-site receptors evaluated quantitatively as a current-use scenario. This approach provides a series of upper-bound estimates.

Future Land Use. Under the current BRAC plan, 1,700 acres comprising the maintenance and administrative areas of the depot were scheduled to be turned over to the Tooele County Economic Development Conveyance (EDC) in 1995 through an interim lease (HOH Associates 1995). To date, none of the 1,700 acres have been turned over. The Tooele County EDA is in the process of preparing an application for an EDC of the entire 1,700-acre parcel. In the interim, the Army is pursuing the interim lease of a number of facilities in cooperation with the EDA. To date, several buildings have been leased to private businesses and several other leases are pending. The open lots, however, remain vacant and are not in use.

Based on this information, some exposure scenarios that are analogous to current-use scenarios described above will continue (i.e., depot staff). However, two additional exposure scenarios unique to planned or potential future use of SWMU 31 were developed:

- Skilled laborers—Individuals assigned to short-term construction in the vicinity of SWMU 31 during potential redevelopment.

- Inhabitants of an on-site residence(s)—Individuals who live in residences established at the time that depot property should ever be transferred for redevelopment.

4.1.4.4.2 ***Characterization of Potential Exposure Pathways.*** An exposure pathway is the route COPCs take to reach potential receptors. Sections 3.1.2.1 and 3.1.2.2 describe the methodology for characterization of exposure pathways. This methodology was then applied to SWMU 31. The following sections describe the potential exposure pathways associated with SWMU 31 for the current and future land use scenarios.

Current Land Use. Currently, the majority of laborers at TEAD work 10-hour days with 4-day weeks. A total of 4 weeks off a year for vacation, holidays, and sick leave yields 192 days per year on the job. It is assumed that a laborer could be at any specific SWMU from 2 central tendency exposure (CTE) hours to 10 reasonable maximum exposure (RME) hours per day and will incidentally ingest, inhale, or become in contact with surface soil through worker-related activities. Military personnel are rotated on assignment an average of every 3 years (S. Culley, personal communication with Rust E&I, 1994). If a laborer is a civilian, the length of assignment could be expected to range as high as 25 years. It is assumed that all of the exposure is from outdoor tasks or activities. Specific parameters relating to ingestion, contact, and ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

Future Land Use. Under the current BRAC plan, the maintenance area that includes SWMU 31 is slated for industrial use/redevelopment. Based on this information, the skilled workers and potential on-site residents are evaluated for future use scenarios. Future SWMU 31 staff,

such as laborers and security personnel, are covered under the current land use scenario described above.

For the future on-site adult resident, it was assumed that at least one parent would spend much of his or her time away from home in activities such as working at another location, household errands, personal care (e.g., medical/dental appointments), or leisure activities. Based on this assumption, the total estimated time an adult will spend at home is approximately 15 to 19 hours per day, during which time he or she may incidentally ingest, inhale, or come in contact with surface soil while conducting activities such as gardening, mowing, or outdoor sports. It is also expected that the future on-site resident will grow and harvest vegetables and fruits from a home garden. For children and adolescents ages 0 to 18, time activity patterns indicate that they spend an average of approximately 30 hours per week away from home to attend school or day care. The total time a child spends at home, averaged over a 7-day week, is approximately 20 hours per day. It is assumed that residents spend 2 (RME) to 4 (CTE) weeks away from home on vacation or long holiday weekends. Therefore, the exposure frequency in real time is 335 days per year (CTE) to 350 days per year (RME). Because the contact rate for ingestion and dermal exposure is in daily units, the exposure frequency for these pathways is prorated into 24-hour-day equivalents. This ranges from 216 days per year (CTE adult) to 276 days per year (CTE child) and from 273 days per year (RME adult) to 288 days per year (RME child) (see Appendix L). Years spent at one residence for the adult/child range from 8 (CTE) to 30 (RME) years based on studies compiled by the USEPA (1989c) and AIHC (1994). Specific parameters relating to ingestion, contact, ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

Based on the continued industrial future usage of SWMU 31, it is possible that industrial construction may be conducted. For these reasons, the future construction worker scenario was evaluated. It is assumed that a construction company could be contracted for a work period ranging from 1 to 3 years and a single worker could be at the site conducting activities outdoors from 2 to 4 months of the year. It is assumed that a worker works as much as 8 to 10 hours per day and may incidentally ingest, inhale, or come in contact with subsurface soil through construction-related activities. Specific parameters relating to ingestion, contact, ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

4.1.4.4.3 ***Exposure Point Concentrations***. The exposure point concentration (EPC) is defined as the concentration of a COPC in an exposure medium that will be contacted over a real or hypothetical exposure duration. EPCs at SWMU 31 were evaluated for current and future land use. Estimation of EPCs is fully described in Appendix L. For brevity, only information specific to SWMU 31 is presented in the following sections.

Current Land Use. EPCs for surface soil ingestion and dermal contact by the SWMU 31 personnel are estimated for the CTE and RME exposure scenario from Phase I and II RI data. EPCs in air for on-site personnel are estimated using USEPA's SCREEN2 model. Details of the estimation of emission rates from surface soils and dispersion modeling are described in Appendix N. Table 4-8 provides the EPCs for on-site personnel associated with SWMU 31.

Table 4-8. Adult Exposure Point Concentrations for SWMU 31

Chemical	Exposure Point Concentration	
	CTE[a]	RME[b]
Current Land Use		
Surface Soil (mg/kg)		
Total PAHs[c]	0.0067	0.0075
Air Emissions (mg/m³)		
Total PAHs	0.00000000023	0.00000000026
Future Land Use [d]		
Surface Soil (mg/kg)		
Total PAHs	0.0025	0.0062
Air Emissions (mg/m³)		
Total PAHs	0.000000000086	0.00000000021
Tubers/Fruits (mg/kg)		
Total PAHs	0.000012	0.00029
Leafy Vegetables (mg/kg)		
Total PAHs	0.0000033	0.0000082

[a]Central tendency exposure.
[b]Reasonable maximum exposure.
[c]Benzo(a)pyrene-equivalent total c-PAH concentration.
[d]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Future Land Use. No COPCs were retained in subsurface soils. For this reason, no future land use scenarios for this media are evaluated further for SWMU 31. Future SWMU 31 staff, such as laborers and security personnel, are covered under the current land use scenario described above.

EPCs for surface soil ingestion, dermal contact, and produce ingestion by hypothetical future on-site residents at SWMU 31 were estimated using methods described in Appendix L. EPCs for inhalation of particulates were modeled, as described in Appendix N, for the hypothetical on-site resident (see Appendix L). The EPCs are given in Tables 4-8 and 4-9.

4.1.4.4.4 ***Estimation of Chemical Intakes***. The exposure models described in detail in Appendix L together with EPCs listed in Tables 4-8 and 4-9 were used to estimate intake for the potential exposure scenarios. Note that averaging time differs for carcinogens and noncarcinogens. Estimates of exposure intakes are given in Tables 4-10 through 4-12.

Table 4-9. Child Exposure Point Concentrations for SWMU 31

Chemical	Exposure Point Concentration CTE[a]	RME[b]
Future Land Use [c]		
Surface Soil (mg/kg)		
Total PAHs[d]	0.0025	0.01
Air Emissions ($\mu g/m^3$)		
Total PAHs	0.000000000086	0.00000000036
Tubers/Fruits (mg/kg)		
Total PAHs	0.00012	0.00048
Leafy Vegetables (mg/kg)		
Total PAHs	0.0000033	0.000014

[a]Central tendency exposure.
[b]Reasonable maximum exposure.
[c]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.
[d]Benzo(a)pyrene-equivalent total c-PAH concentration.

4.1.4.5 *Toxicity Assessment*

Information of the toxicological effects of carcinogenic and systemic toxicants are summarized in Appendix M. This toxicity assessment includes brief toxicity profiles on data listed in USEPA's IRIS database and published in HEAST (USEPA 1994c). These profiles describe the acute, chronic, and carcinogenic health effects associated with SWMU-related chemicals. Toxicity values for COPCs associated with areas of concern for SWMU 31 are summarized in Tables 4-10 through 4-12.

4.1.4.6 *Risk Characterization*

This section provides a characterization of the potential health risks associated with the intake of chemicals associated with the SWMU 31. The risk characterization compares estimated potential incremental lifetime cancer risks (ILCRs) with reasonable levels of risk for potential carcinogens (see Section 3.1.4.1), and the estimated daily intake of systemic toxicants with appropriate reference levels. Some carcinogenic chemicals may also pose a systemic hazard, and these potential hazards are characterized as for other systemic toxicants.

Table 4-10. Summary of Potenital Carcinogenic Risk Results for the Current/Future On-site Laborer for SWMU 31

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Total PAHs[d]	6.7E-03	6.4E-13	7.3E+00	4.7E-12	
			Pathway Total:	4.7E-12	50%
Dermal Contact with Surface Soil					
Total PAHs	6.7E-03	3.2E-13	1.5E+01	4.7E-12	
			Pathway Total:	4.7E-12	50%
Inhalation of Particulates					
Total PAHs	2.3E-10	NA[e]	NA	NA	
			Pathway Total:	NA	NA
			Total CTE ILCR:	9.3E-12	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Total PAHs	7.5E-03	5.7E-10	7.3E+00	4.2E-09	
			Pathway Total:	4.2E-09	30%
Dermal Contact with Surface Soil					
Total PAHs	7.5E-03	6.6E-10	1.5E+01	9.7E-09	
			Pathway Total:	9.7E-09	70%
Inhalation of Particulates					
Total PAHs	2.6E-10	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME ILCR:	1.4E-08	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]Benzo(a)pyrene-equivalent total carcinogenic PAH concentration.
[e]NA denotes not applicable. These COPC were not quantitatively included because they do not have toxicity values specific to this pathway.

Table 4-11. Summary of Potential Carcinogenic Risk Results for the Future On-site Adult Resident for SWMU 31

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Total PAHs[d]	2.5E-03	2.2E-11	7.3E+00	1.6E-10	
			Pathway Total:	1.6E-10	3%
Dermal Contact with Surface Soil					
Total PAHs	2.5E-03	1.1E-11	1.5E+01	1.6E-10	
			Pathway Total:	1.6E-10	3%
Inhalation of Particulates					
Total PAHs	8.6E-11	NA[e]	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Total PAHs	3.3E-06	4.9E-11	7.3E+00	3.6E-10	
			Pathway Total:	3.6E-10	7%
Ingestion of Tubers and Fruits					
Total PAHs	1.2E-05	5.8E-10	7.3E+00	4.2E-09	
			Pathway Total:	4.2E-09	86%
			Total CTE ILCR:	4.9E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Total PAHs	6.2E-03	1.3E-09	7.3E+00	9.4E-09	
			Pathway Total:	9.4E-09	1%
Dermal Contact with Surface Soil					
Total PAHs	6.2E-03	1.5E-09	1.5E+01	2.2E-08	
			Pathway Total:	2.2E-08	2%
Inhalation of Particulates					
Total PAHs	2.1E-10	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Total PAHs	8.2E-06	1.6E-09	7.3E+00	1.2E-08	
			Pathway Total:	1.2E-08	1%
Ingestion of Tubers and Fruits					
Total PAHs	2.9E-04	1.9E-07	7.3E+00	1.4E-06	
			Pathway Total:	1.4E-06	97%
			Total RME ILCR:	1.4E-06	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]Benzo(a)pyrene-equivalent total carcinogenic PAH concentration.
[e]NA denotes not applicable. These COPC were not quantitatively included because they do not have toxicity values specific to this pathway.

Table 4-12. Summary of Potential Carcinogenic Risk Results for the Future On-site Child Resident for SWMU 31

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Total PAHs[d]	2.5E-03	9.9E-11	7.3E+00	7.2E-10	
			Pathway Total:	7.2E-10	1.0%
Dermal Contact with Surface Soil					
Total PAHs	2.5E-03	1.8E-11	1.5E+01	2.7E-10	
			Pathway Total:	2.7E-10	0.4%
Inhalation of Particulates					
Total PAHs	8.6E-10	NA[e]	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Total PAHs	3.3E-06	8.0E-11	7.3E+00	5.8E-10	
			Pathway Total:	5.8E-10	0.8%
Ingestion of Tubers and Fruits					
Total PAHs	1.2E-04	9.4E-09	7.3E+00	6.8E-08	
			Pathway Total:	6.8E-08	97.7%
			Total CTE ILCR:	7.0E-08	100.0%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Total PAHs	1.0E-02	4.4E-09	7.3E+00	3.2E-08	
			Pathway Total:	3.2E-08	2.1%
Dermal Contact with Surface Soil					
Total PAHs	1.0E-02	1.0E-09	1.5E+01	1.5E-08	
			Pathway Total:	1.5E-08	0.9%
Inhalation of Particulates					
Total PAHs	3.6E-10	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Total PAHs	1.4E-05	1.8E-09	7.3E+00	1.3E-08	
			Pathway Total:	1.3E-08	0.8%
Ingestion of Tubers and Fruits					
Total PAHs	4.8E-04	2.1E-07	7.3E+00	1.5E-06	
			Pathway Total:	1.5E-06	96.2%
			Total RME ILCR:	1.6E-06	100.0%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]Benzo(a)pyrene-equivalent total carcinogenic PAH concentration.
[e]NA denotes not applicable. These COPC were not quantitatively included because they do not have toxicity values specific to this pathway.

4.1.4.6.1 *Characterization of Potential Carcinogenic Risks*

Current/Future On-site Laborer. The cumulative ILCR for all pathways does not exceed the lower bound of the target risk range. Estimated ILCRs for all pathways range from 1.4E-08 and 9.3E-12 for the RME and CTE scenarios, respectively, as summarized in Table 4-10.

Future On-site Adult Resident. The cumulative ILCR for all pathways does not exceed the lower bound of the target risk range. Estimated ILCRs for all pathways range from 1.4E-06 to 4.9E-09 for the RME and CTE scenarios, respectively. As summarized in Table 4-11, the driving pathway is ingestion of produce, which contributes greater than 93 percent of the estimated risk.

Incremental lifetime cancer risk attributed to ingestion of produce, such as homegrown vegetables, by adults results in an estimated ILCR of 1.4E-06 and 4.6E-09 using RME and CTE parameters, respectively. The ILCR for the remaining pathways evaluated—ingestion of surface soil, dermal contact with surface soil, and inhalation of particulates—is below the target risk range for both the RME and CTE scenarios, and ranges from 2.2E-08 to 1.6E-10. Total carcinogenic PAHs are the only contributors to the estimated risk.

Future On-site Child Resident. The cumulative ILCR for all pathways are within or below the lower bound of the target risk range. Estimated ILCRs for all pathways range from 1.6E-06 to 7.0E-08 for the RME and CTE scenarios, respectively. As summarized in Table 4-12, the driving pathway is ingestion of produce which contributes greater than 97 percent of the estimated risk.

Incremental lifetime cancer risk attributed to ingestion of produce, such as homegrown vegetables, by children results in an estimated ILCR of 1.5E-06 and 6.8E-08 using RME and CTE parameters, respectively. The ILCR for the remaining pathways evaluated—ingestion of surface soil, dermal contact with surface soil and inhalation of particulates—is below the target risk range for both the RME and CTE scenarios, and ranges from 3.2E-08 to 2.7E-10. Total carcinogenic PAHs are the only contributors to the estimated risk.

4.1.4.6.2 ***Characterization of Potential Systemic Effects.*** HIs for current and future land use scenarios could not be estimated since noncarcinogens reference dose information is not available for the COPCs associated with SWMU 31.

4.1.4.7 *Risk Assessment Summary and Conclusions*

An RA was conducted for the Former Transformer Boxing Area based on Phase I and Phase II RI data. Due to a lack of subsurface COPCs, three scenarios—on-site laborer/security worker, on-site adult resident, and on-site child resident—were quantitatively evaluated. For these scenarios, an RME and CTE (or "most-likely-to-occur") were evaluated. Estimates were found to fall within or below the target ranges for tolerable ILCRs. A hazard index (HI) was not

estimated for these scenarios because reference dose information is not currently available for COPCs associated with SWMU 31.

Tables 4-13 and 4-14 summarize the RME and CTE ICLRs for current and future land use scenarios.

The risk assessment results indicate that risks to human health from the presence of low levels of hazardous chemicals at SWMU 31 are at acceptable levels (within or below risk-based criteria). Therefore, no remedial action is recommended.

4.1.5 Conclusions and Recommendations

The analyte suite for SWMU 31 consisted of PCBs, metals, SVOCs, and VOCs. Analysis of surface soil samples collected during the 1994 field effort revealed no PCB or VOC contamination. Although the SVOCs benzo[a]anthracene, benzo[b]fluoranthene, chrysene, fluoranthene, phenanthrene, pyrene, and bis(2-ethylhexyl)phthalate were detected in low concentrations, it is believed that the SVOCs detected are associated with leakage of fluids from the vehicles that were stored on site at the time of the Phase II field investigation. These vehicles have subsequently been removed, thereby eliminating the suspected source of SVOC contamination. The only metal detected was lead at concentrations twice the calculated background (18.2 μg/g) level. However, these concentrations were well below the OSWER recommended clean-up level of 400 μg/g (ppm) for lead in residential soil. It is important to note that additional soil sampling for antimony and thallium may be necessary prior to releasing the land for future residential use. This information will be carried forward through the FS and ROD process.

A baseline human health risk assessment was conducted at the Former Transformer Boxing Area to determine any potential human health risks associated with a no-action alternative. COPCs were evaluated using USEPA guidance and procedures, which concluded that total PAHs were the only COPCs identified at this SWMU and that all risks were within or below regulatory criteria. Ecological risk results for SWMU 31 are presented in the TEAD Site-Wide Ecological Risk Assessment (SWERA) report (Rust E&I 1996).

Based on the results of the human health risk assessments, no adverse effect to human health should arise. Therefore, it is recommended that no further remedial investigations be conducted. A feasibility study will be conducted for SWMU 31, as required by CERCLA, to determine if any other remedies are required for this SWMU. Conclusions from this report and the SWERA will be used during the FS process to derive final recommendations for SWMU 31.

Table 4-13. Summary of CTE Risk Results for SWMU 31

	SWMU as a Whole	
Scenario	**HI**	**ILCR**
Current Land Use		
On-site Laborer	---	9.3E-12
Future Land Use		
On-site Adult Resident	---	4.9E-09
On-site Child Resident	---	7.0E-08

Table 4-14. Summary of RME Risk Results for SWMU 31

	SWMU as a Whole	
Scenario	**HI**	**ILCR**
Current Land Use		
On-site Laborer	---	1.4E-08
Future Land Use		
On-site Adult Resident	---	1.4E-06
On-site Child Resident	---	1.6E-06

4.2 PCB SPILL SITE (SWMU 32)

4.2.1 Site Characteristics

The PCB Spill Site is located in the southern portion of Open Storage Lot 665D (Figure 4-3) within the industrial BRAC parcel. In October of 1980, a transformer oil spill occurred at the southeastern corner of the lot. Two transformers, reportedly containing a total of 1,000 gallons of PCB-contaminated oil, were punctured with a fork-lift blade during transformer-removal operations. The spill occurred on the unpaved ground surface, reportedly over less than one-half acre. Cleanup involved excavating oil-saturated soils, containerizing the soils in 55-gallon drums, and disposing these drums. Some of the oil leaking from the transformers was collected and was also placed in 55-gallon drums for disposal. Approximately 440 55-gallon drums of contaminated soil and 18 drums of contaminated oil were removed (EA 1988). The excavation area was backfilled with imported fill material. Lot 665D was used for vehicle-related equipment storage at the time of the Phase II RI. The southeastern corner of the lot was cleared of all stored equipment for the Phase II RI field investigation. This SWMU is within the BRAC parcel, and equipment has since been sold or transferred to the Red River Army Depot, Texas.

4.2.2 Previous Investigations and Phase I and Phase II RI Activities

EA Engineering, Science, and Technology, Inc. (EA) conducted a site investigation at the PCB Spill Site (SWMU 32) to confirm that the soils remaining after the excavation were not contaminated with PCBs (EA 1988). A total of 17 discrete surface-soil samples were collected by EA from an area measuring approximately 45 feet by 50 feet (Figure 4-4). A total of 3 of the 20 proposed samples could not be collected because equipment covered the sampling locations. The samples were composited into five samples (PCB-SLC1 through PCB-SLC5), which were analyzed for the PCB Aroclors 1016, 1254, and 1260. Aroclor 1260 was detected in all five samples, ranging from 0.0764 to 0.2140 μg/g. If it were assumed that one of the discrete samples in a composite contained all the PCBs, a maximum concentration of approximately 0.64 μg/g can be calculated. This result is below the USEPA guidelines (USEPA 1990) of 1 μg/g and Toxic Substances Control Act (TSCA) cleanup standards of 10 μg/g. TSCA's cleanup standard for soil applies to PCB spills in nonrestricted access areas with at least 10 inches of soil removed and 10 inches of clean soil cover (having less than 1 μg/g PCBs) applied to the affected area (40 CFR761.125(c)(4)). On the basis of these findings, no additional investigations were proposed for the Phase I RI.

Following Phase I, further review of the previous investigations was conducted at this site, and it was determined that additional sampling would be necessary to satisfy regulatory requirements. As a result, a field investigation was conducted during the Phase II RI effort. Phase II RI field activities consisted of surface- and subsurface-soil sampling at SWMU 32. The sample locations were selected by randomly placing sample points on a 50-by-40-foot grid pattern over the entire PCB Spill Site Area (Figure 4-3). Surface soil samples were collected at seven selected grid locations to determine the horizontal extent of PCB-contaminated soils.

Also, eight soil borings were drilled to a depth of up to 13 feet primarily to determine if residual contamination is present below the previous excavation. On the basis of information obtained from TEAD-EMO personnel, the maximum depth of cleanup at the site was from 8 to 10 feet. Samples from the borings were collected at 0 to 6 inches and 5 feet, and from a 10-to-13-foot composite. All soil samples were analyzed for PCBs. In addition, one-third of the samples were analyzed for metals, SVOCs, and VOCs to determine whether contaminants other than PCBs have been released to SWMU 32 soils.

4.2.3 Contamination Assessment

4.2.3.1 *Data Evaluation*

This section evaluates the analytical data for its usability in the risk assessment. A data evaluation was performed by reviewing the data quality codes assigned by the USAEC Chemistry Branch and EcoChem, an independent third-party validator. In an effort to ascertain the level of certainty/uncertainty, USEPA data qualification codes were then assigned as an aid in interpreting the data for use in the risk assessment. (Table 2-4 defines the relationship between the USAEC Chemistry Branch codes and USEPA data qualifiers.) The following sections summarize the results of this process.

4.2.3.1.1 ***Field Duplicates.*** The "D" flag code represents a field duplicate. All "D" flagged data were compared with the primary investigative result, and the higher of the two values was used in the quantitative risk assessment.

4.2.3.1.2 ***Blank Assessment.*** The USEPA has determined that when blank contamination exists, the investigative results must exceed the blank result by a factor of 5 (all compounds) or 10 (common laboratory contaminants such as acetone) in order to be considered positive. Several metals were detected in method and/or other blanks associated with SWMU 32 soil samples. Based on comparisons to blanks, positive metals results were changed to nondetects for the following samples. Per USEPA guidance (USEPA 1989), the associated blank concentration was considered the quantitation limit for the affected samples.

- Surface Soil
  -None

- Subsurface Soil
  -Aluminum—PPB-94-01B, -01C, and -03C
  -Iron—PPB-94-01B, -01C, -03B, and -03C
  -Manganese—PPB-94-01C
  -Potassium—PPB-94-01B and -01C

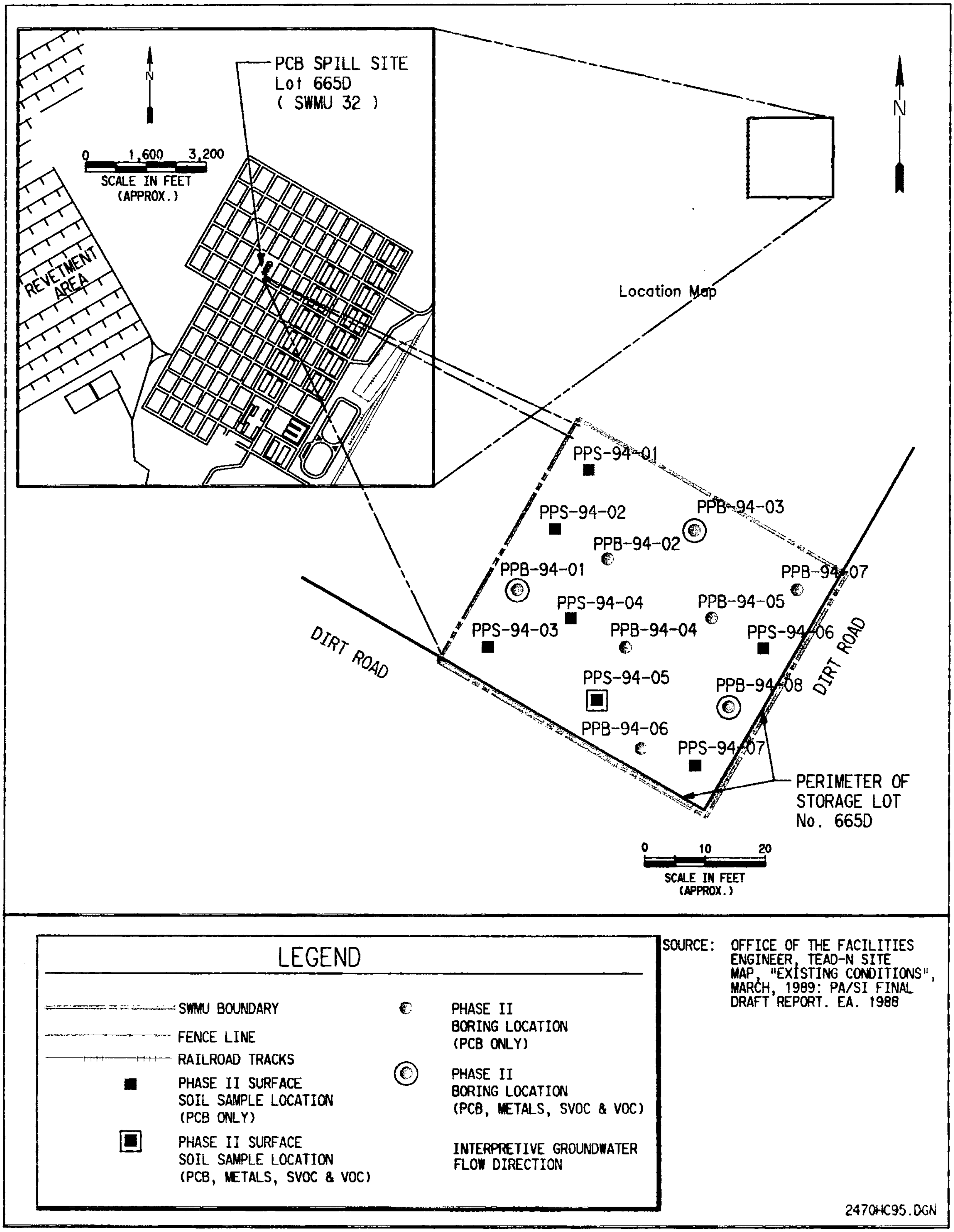


Figure 4-3. SWMU 32 Location Map and Phase II Sample Results

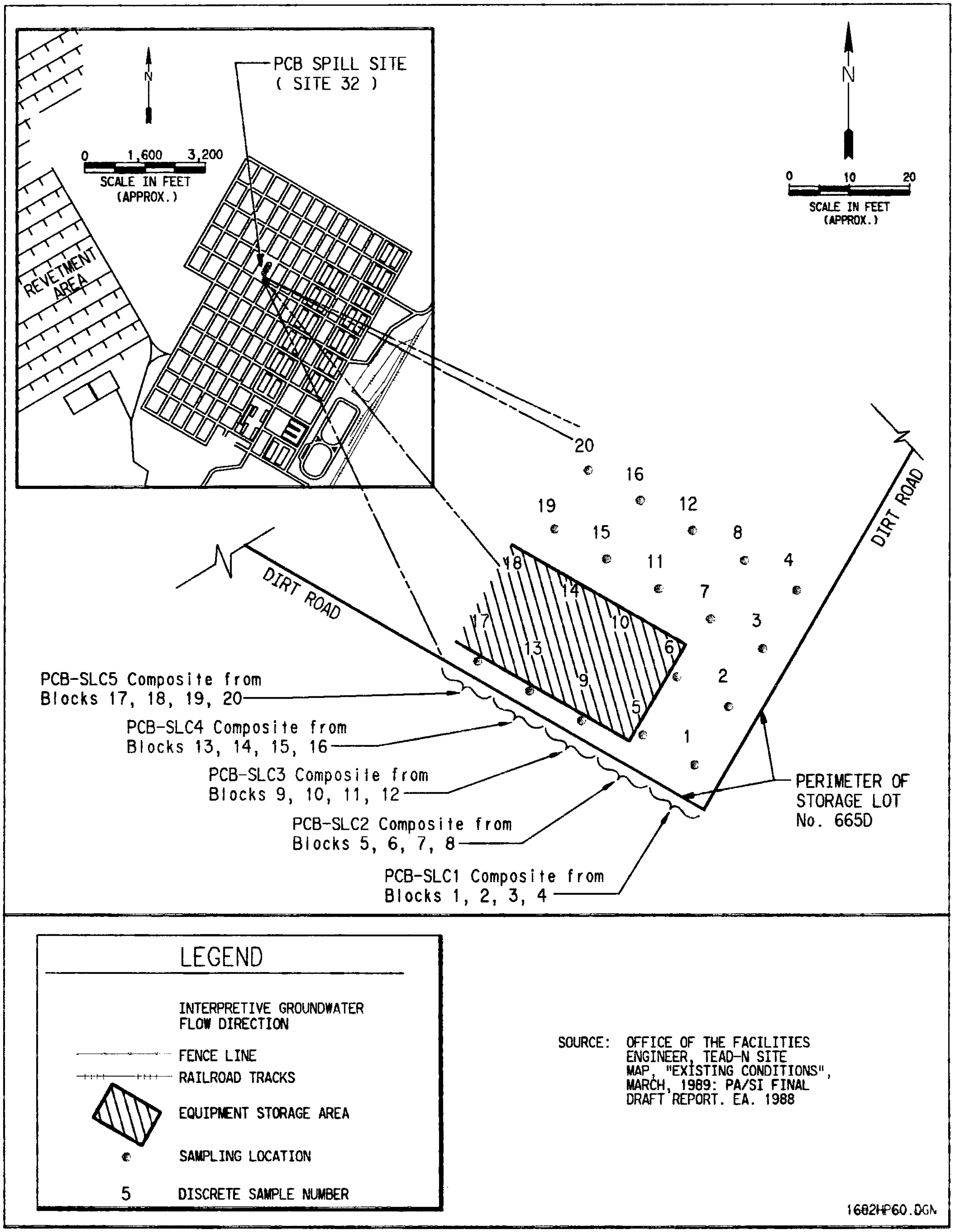


Figure 4-4 Previous Investigation Sample Results

4.2.3.1.3 ***USAEC Chemistry Branch Validation.*** The USAEC Chemistry Branch reviewed the analytical data for technical deficiencies based on the *USATHAMA (USAEC) Quality Assurance Program (PAM 11-41)*. USAEC data qualifiers assigned by the Chemistry Branch would be an indication of QC recoveries outside of USAEC control limits and other technical deficiencies. Estimating the data for use in the risk assessment based on USAEC data qualifiers is judged to be a conservative approach since USAEC control limits are generally narrower than USEPA Functional Guidelines. For SWMU 32, the USAEC assigned qualifiers to mercury in Lot ANUB due to a high low-spike recovery (145 percent). Detected values below the high-spike concentration were estimated (J) and considered biased high. No data were rejected for use.

Non-Certified Compounds. USAEC flag codes of R or T were assigned by the analytical laboratory to indicate non-detected compounds, which had not been performance demonstrated or validated under the USAEC's 1990 QA program. Under this program, a distinction is made between "target" and "non-target" analytes. "Target" compounds are determined during the certification process, and CRLs for these analytes are established. "Non-target" compounds are those that were added to the method to meet project-specific requirements. The lowest calibration standard typically reflects the PQL for that analyte. For the purpose of the risk assessment, the detection limit will be assigned a J-code, due to the uncertainty associated with not having undergone a rigorous certification process.

4.2.3.1.4 ***Independent Third-Party Data Validation.*** A data quality assessment was completed using a validation effort by EcoChem, an independent third party. EcoChem's review and recommendations were based on USEPA Functional Guidelines as well as the *USATHAMA (USAEC) Quality Assurance Program (PAM 11-41)* and individual methods. All USEPA data qualifiers recommended by EcoChem were incorporated for use in the risk assessment and are provided in the analytical summary tables of Appendix J.

For SWMU 32, EcoChem evaluated one lot of ICP metals analyses of soil samples by Method JS12 and one lot of semivolatile organic analyses of soil samples by Method LM25.

For the ICP-metals analyses, Lot ANVM, EcoChem rejected all antimony detection limits due to 0 percent recovery in the MS/MSD. The USAEC did not flag this problem because natural spikes are not part of the USAEC QA program.

For the semivolatile analyses, Lot ANUH, EcoChem rejected (R) toxaphene and three PCB aroclor (1016, 1260, 1262) reporting limits. These compounds were not scanned for (except as unknown compounds). Data qualifiers (J, UJ) were assigned to several analytes due to calibration outliers and low internal standard areas (see EcoChem transfer sheets in Appendix J for analytes and sample IDs).

The sample results rejected for use in the risk assessment are as follows:

- Surface Samples
  –Toxaphene—PPB-94-03A, PPS-94-05
  –PCB 1016—PPB-94-03A, PPS-94-05
  –PCB 1260—PPB-94-03A, PPS-94-05
  –PCB 1262—PPB-94-03A, PPS-94-05
  –Antimony—PPB-94-01A, -03A, -08A and PPS-94-05

- Subsurface Samples
  –Toxaphene—PPB-94-03B, -03C
  –PCB 1016—PPB-94-03B, -03C
  –PCB 1260—PPB-94-03B, -03C
  –PCB 1262—PPB-94-03B, -03C
  –Antimony—PPB-94-01B, -01C, -03B, -03C, -08B, 08C

4.2.3.1.5 ***Data Evaluation Summary.*** A total of 15 surface soil samples (and 1 duplicate) and 16 subsurface samples were collected in 1994 from 8 soil borings and 7 surface locations at SWMU 32. Samples from the borings were collected at 0, 5, and 10 to 13 feet. All samples were analyzed for PCBs. In addition, one-third of the samples were analyzed for metals, semivolatiles, and volatiles.

Because of blank contamination, positive results for aluminum, iron, manganese, and potassium were changed to nondetects in a few samples. The detected values in the affected samples were below background screening levels for the metals, indicating that this issue does not significantly impact the risk assessment results.

Antimony and thallium were not detected in any soil samples. The antimony and thallium reporting limits exceed the background screening values and the ingestion RBCs for these metals. Additionally, 10 antimony nondetect results were rejected due to poor matrix spike recoveries. Therefore, the magnitude and extent of antimony and thallium contamination may not be adequately characterized at this SWMU. However, the PRGs for these metals established by Dames and Moore (1996) under current industrial land use conditions are much higher than the reporting limits indicating that no data gap exists. Further evaluation might be required prior to release of the property for residential land use.

Reporting limits for cadmium (1.2 μg/g) and silver (0.80 μg/g) were above their respective background screening values but less than their respective ingestion and soil-to-air RBCs. Therefore, this issue does not significantly impact the risk assessment results. Several semivolatile samples had reporting limits estimated due to a possibility of low bias as a result of decreased instrument sensitivity.

Approximately 95 percent of sample results were judged to be usable for risk assessment purposes. The number of samples and the analytical parameter list appear to be sufficient to characterize the nature, extent, and potential magnitude of contamination at this SWMU with exceptions noted above. A summary of chemicals detected in at least one surface or subsurface soil sample at SWMU 32 is presented in Appendix J, including corresponding data qualifiers (as appropriate) based on USEPA functional guidelines.

4.2.3.1.6 ***Background Screening.*** The maximum concentrations of inorganic chemicals detected in soil at SWMU 32 were compared to the site-specific background screening values (see Section 2.6). Any inorganic chemical detected in at least one sample at a concentration higher than the background screening value was retained in the COPC database. Surface soil and subsurface soil were screened separately. The results of the background screening are shown in Table 4-15. Based on this screening analysis, arsenic, cadmium, chromium, copper, lead, magnesium, and sodium are considered preliminary COPCs for surface soil at this SWMU. Although silver and thallium were not detected in surface soil at this site, the CRLs for these metals were higher than their respective background screening values.

In subsurface soil, calcium, chromium, and magnesium remain as preliminary inorganic COPCs for this site. Cadmium, silver, and thallium, which were not detected, had CRLs that were higher than their respective background screening values.

4.2.3.2 *Summary of Analytical Results*

The list of analytes detected in at least one surface or subsurface soil sample is provided in Table 4-16 for Phase II data. The complete data set is contained in Appendix H.

4.2.3.3 *Nature and Extent of Contamination*

The initial focus of the Phase II RI investigation was on the potential for residual PCB-contaminated soil at this site. Sampling locations are shown in Figure 4-5. No PCBs were detected in any of the samples collected at this site during the Phase II RI investigation. Additional analyses for metals, VOCs, and SVOCs were conducted to determine if any other contaminants are present at the site. Metals that were detected in above background concentrations (with maximum concentrations in parentheses) include arsenic (16.1 μg/g), cadmium (4.01 μg/g), chromium (54 μg/g), copper (26.2 μg/g), and lead (70.6 μg/g) (Table 4-15). Low concentrations of SVOCs were also detected in the surface and subsurface soil at the site, with a maximum concentration of 1.8 μg/g of di-n-butyl phthalate in sample PPB-94-08C at a depth of 13 feet.

Soil boring PPB-94-01 contained chromium in each sample at concentrations ranging from 34.8 μg/g in the surface sample to 40.2 μg/g in the sample collected at 11 feet. Lead was detected at 27.7 μg/g in the surface sample only. Soil boring PPB-94-03 contained chromium at 26.7 μg/g in the surface sample and 35.4 μg/g in the sample collected at 11 feet. Lead was detected at 18.9 μg/g in the surface sample only. The intermediate sample collected at 5 feet did not contain metals in excess of background concentrations. Soil boring PPB-94-08 contained chromium in concentrations ranging from 23.8 μg/g in the surface sample to 54 μg/g in the sample collected at 13 feet. Lead was detected at 23.7 μg/g in the surface sample only. Surface-soil sample PPS-94-05 contained arsenic (16.1 μg/g), cadmium (4.01 μg/g), copper (26.2 μg/g), and lead (70.6 μg/g) in excess of respective background concentrations (Figure 4-5).

Table 4-15. Background Screening of Inorganic Chemicals Detected in Soil at SWMU 32

Chemical	Frequency of Detection[a]	Maximum Detected Value (μg/g)	Site-specific Background Screening Value[b] (μg/g)	Exceeds Site-specific Background?
Surface Soil				
Aluminum	4/4	16,800	28,083	No
Arsenic	4/4	16.1	11.69	**YES**
Barium	4/4	175	247	No
Beryllium	4/4	0.744	1.46	No
Cadmium	1/4	4.01	0.847	**YES**
Calcium	4/4	84,000	114,483	No
Chromium	4/4	34.8	20.62	**YES**
Cobalt	4/4	5.95	6.94	No
Copper	4/4	26.2	24.72	**YES**
Iron	4/4	15,800	22,731	No
Lead	4/4	70.6	18.23	**YES**
Magnesium	4/4	10,100	7,062	**YES**
Manganese	4/4	463	698	No
Mercury	2/4	0.0553	0.0572	No
Nickel	4/4	11.8	17.40	No
Potassium	4/4	5,030	5,450	No
Sodium	4/4	347	337	**YES**
Vanadium	4/4	23.2	28.39	No
Zinc	4/4	83.7	102.8	No
Subsurface Soil				
Aluminum	3/6	8,320	28,083	No
Arsenic	6/6	7.22	11.69	No
Barium	6/6	87.9	247	No
Calcium	6/6	140,000	114,483	**YES**
Chromium	6/6	54	20.62	**YES**
Cobalt	1/6	2.72	6.94	No
Copper	6/6	10.4	24.72	No
Iron	2/6	7,320	22,731	No
Lead	2/6	15	18.23	No
Magnesium	6/6	10,900	7,062	**YES**
Manganese	5/6	182	698	No
Nickel	6/6	11.9	17.40	No
Potassium	4/6	2,600	5,450	No
Sodium	6/6	206	337	No
Vanadium	6/6	21.6	28.39	No
Zinc	6/6	31.3	102.8	No

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]See Section 2.6.1.1 for an explanation of how the site-specific background screening values were calculated.

Table 4-16. Summary of Analytes Detected in Soil for the PCB Spill Site (SWMU 32) - Phase II

			Surface Soil											
Group	Analytes	Background Concentrations	PPS-94-01A (0.5ft)	PPS-94-02A (0.5ft)	PPS-94-03A (0.5ft)	PPS-94-04A (0.5ft)	PPS-94-05A (0.5ft)	PPS-94-06A (0.5ft)	PPS-94-07A (0.5ft)	PPS-94-08A (0.5ft)	PPS-94-01 (0.5ft)	PPS-94-02 (0.5ft)	PPS-94-03 (0.5ft)	PPS-94-04 (0.5ft)
METALS	ALUMINUM	28083	16800	NT	12900	NT	NT	NT	NT	12200	NT	NT	NT	NT
	ARSENIC	11.69	10.9	NT	7.4	NT	NT	NT	NT	7.21	NT	NT	NT	NT
	BARIUM	247.1	176	NT	126	NT	NT	NT	NT	140	NT	NT	NT	NT
	BERYLLIUM	1.466	0.744	NT	0.63	NT	NT	NT	NT	0.64	NT	NT	NT	NT
	CADMIUM	0.847	LT 1.2	NT	LT 1.2	NT	NT	NT	NT	LT 1.2	NT	NT	NT	NT
	CALCIUM	114483	41300	NT	82000	NT	NT	NT	NT	84000	NT	NT	NT	NT
	CHROMIUM	20.62	34.6*	NT	26.7*	NT	NT	NT	NT	23.8*	NT	NT	NT	NT
	COBALT	6.94	5.96	NT	4.67	NT	NT	NT	NT	4.22	NT	NT	NT	NT
	COPPER	24.72	20.2	NT	14.6	NT	NT	NT	NT	16.6	NT	NT	NT	NT
	IRON	22731	15800	NT	10800	NT	NT	NT	NT	11400	NT	NT	NT	NT
	LEAD	18.23	27.7*	NT	18.9*	NT	NT	NT	NT	23.7*	NT	NT	NT	NT
	MAGNESIUM	7081	10100*	NT	9530*	NT	NT	NT	NT	9580*	NT	NT	NT	NT
	MANGANESE	698.3	483	NT	290	NT	NT	NT	NT	332	NT	NT	NT	NT
	MERCURY	0.0672	0.0563	NT	LT 0.05	NT	NT	NT	NT	0.066	NT	NT	NT	NT
	NICKEL	17.4	11.8	NT	8.52	NT	NT	NT	NT	10.1	NT	NT	NT	NT
	POTASSIUM	6449	6030	NT	3790	NT	NT	NT	NT	4000	NT	NT	NT	NT
	SODIUM	337	347*	NT	274	NT	NT	NT	NT	310	NT	NT	NT	NT
	VANADIUM	28.39	21.6	NT	23.2	NT	NT	NT	NT	18	NT	NT	NT	NT
	ZINC	102.8	61.9	NT	43.8	NT	NT	NT	NT	49.7	NT	NT	NT	NT
SEMIVOLATILES	BENZYL ALCOHOL	N/A	LT 0.032	NT	0.072*	NT	NT	NT	NT	LT 0.032	NT	NT	NT	NT
	FLUORANTHENE	N/A	LT 0.032	NT	LT 0.032	NT	NT	NT	NT	LT 0.032	NT	NT	NT	NT

Group	Analytes	Background Concentrations	PPS-94-04(D) (0.5ft)	PPS-94-05 (0.5ft)	PPS-94-06 (0.5ft)	PPS-94-07 (0.5ft)
METALS	ALUMINUM	28083	NT	11000	NT	NT
	ARSENIC	11.69	NT	16.1*	NT	NT
	BARIUM	247.1	NT	113	NT	NT
	BERYLLIUM	1.466	NT	0.491	NT	NT
	CADMIUM	0.847	NT	4.01*	NT	NT
	CALCIUM	114483	NT	48600	NT	NT
	CHROMIUM	20.62	NT	19.7	NT	NT
	COBALT	6.94	NT	3.96	NT	NT
	COPPER	24.72	NT	26.2*	NT	NT
	IRON	22731	NT	10900	NT	NT
	LEAD	18.23	NT	70.6*	NT	NT
	MAGNESIUM	7081	NT	7800*	NT	NT
	MANGANESE	698.3	NT	306	NT	NT
	MERCURY	0.0672	NT	LT 0.05	NT	NT
	NICKEL	17.4	NT	8.74	NT	NT
	POTASSIUM	6449	NT	3390	NT	NT
	SODIUM	337	NT	234	NT	NT
	VANADIUM	28.39	NT	17.9	NT	NT
	ZINC	102.8	NT	83.7	NT	NT
SEMIVOLATILES	BENZYL ALCOHOL	N/A	NT	0.048*	NT	NT
	FLUORANTHENE	N/A	NT	0.047*	NT	NT

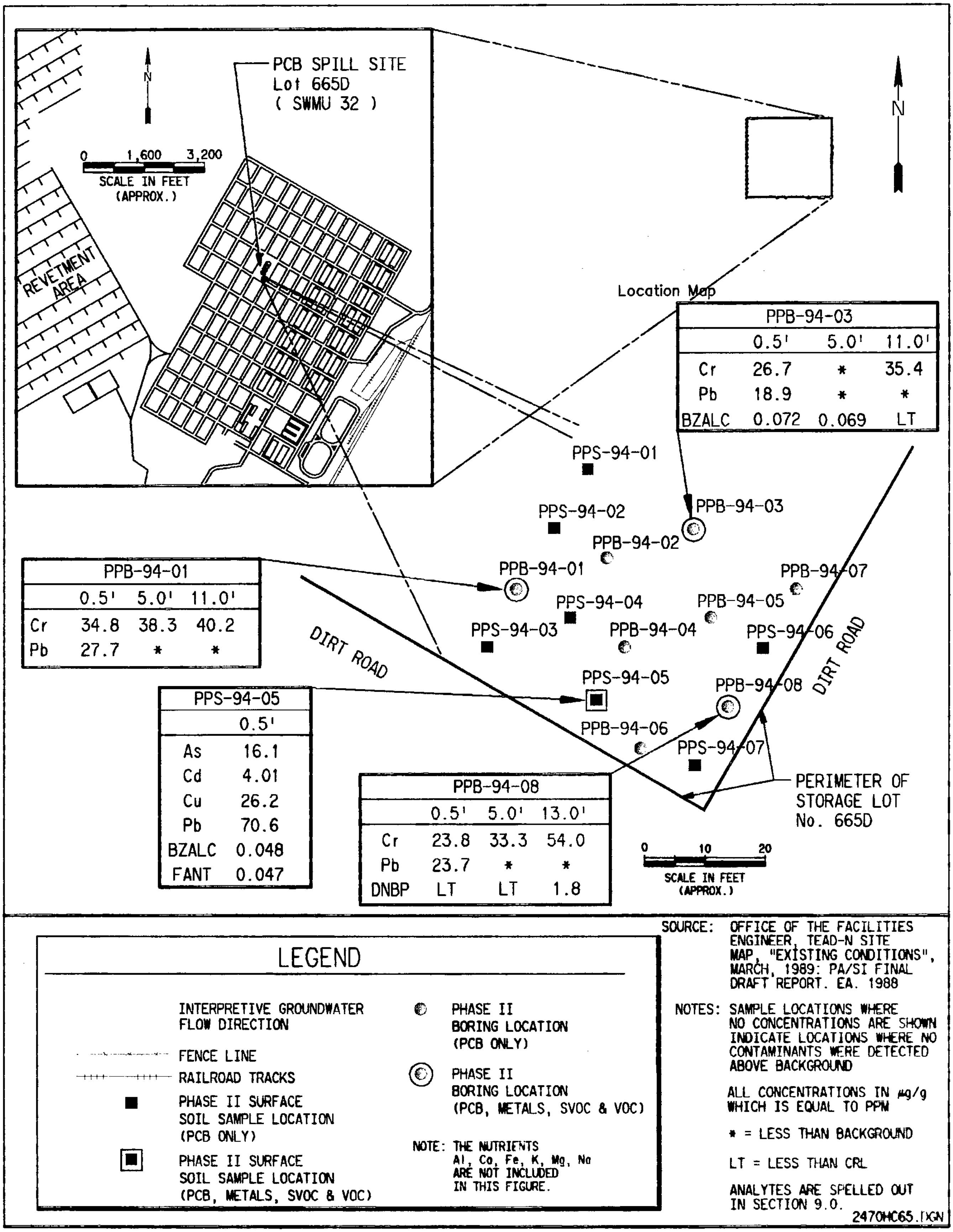
Table 4-16. *Summary of Analytes Detected in Soil for the PCB Spill Site (SWMU 32) - Phase II (continued)*

Subsurface Soil

Group	Analytes	Background Concentrations	PPB-94-01B (5ft)	PPB-94-01C (11ft)	PPB-94-02B (5ft)	PPB-94-02C (10ft)	PPB-94-03B (5ft)	PPB-94-03C (11ft)	PPB-94-04B (5ft)	PPB-94-04C (11ft)	PPB-94-05B (5ft)	PPB-94-05C (11ft)	PPB-94-06B (5ft)	PPB-94-06C (11ft)
METALS	ALUMINUM	28083	2760#	2420#	NT	NT	4030	3870#	NT	NT	NT	NT	NT	NT
	ARSENIC	11.69	4.73	4.38	NT	NT	8.04	4.8	NT	NT	NT	NT	NT	NT
	BARIUM	247.1	33.9#	16.8#	NT	NT	66.9	26.1#	NT	NT	NT	NT	NT	NT
	CALCIUM	114483	140000*	140000*	NT	NT	120000*	130000*	NT	NT	NT	NT	NT	NT
	CHROMIUM	20.62	38.3*	40.2*	NT	NT	18.1	35.4*	NT	NT	NT	NT	NT	NT
	COBALT	6.94	LT 2.6	LT 2.6	NT	NT	LT 2.6	LT 2.6	NT	NT	NT	NT	NT	NT
	COPPER	24.72	4.12	3.24	NT	NT	7.97	5.91	NT	NT	NT	NT	NT	NT
	IRON	22731	3260#	3380#	NT	NT	4750#	4600#	NT	NT	NT	NT	NT	NT
	LEAD	18.23	LT 7.44	LT 7.44	NT	NT	14.1	LT 7.44	NT	NT	NT	NT	NT	NT
	MAGNESIUM	7061	8310*	6310	NT	NT	7760*	7960*	NT	NT	NT	NT	NT	NT
	MANGANESE	698.3	114	72.2#	NT	NT	123	103	NT	NT	NT	NT	NT	NT
	NICKEL	17.4	8.22	6.66	NT	NT	8.01	7.83	NT	NT	NT	NT	NT	NT
	POTASSIUM	6449	899#	863#	NT	NT	1200	1170	NT	NT	NT	NT	NT	NT
	SODIUM	337	114	72.3	NT	NT	137	96.2	NT	NT	NT	NT	NT	NT
	VANADIUM	28.39	11.7	10.9	NT	NT	21.6	21.3	NT	NT	NT	NT	NT	NT
	ZINC	102.8	10.9	15.7	NT	NT	26.2	21.2	NT	NT	NT	NT	NT	NT
SEMIVOLATILES	BENZYL ALCOHOL	N/A	LT 0.032	LT 0.032	NT	NT	0.069*	LT 0.032	NT	NT	NT	NT	NT	NT

Group	Analytes	Background Concentrations	PPB-94-07B (5ft)	PPB-94-07C (10ft)	PPB-94-08B (5ft)	PPB-94-08C (13ft)
METALS	ALUMINUM	28083	NT	NT	8320	5510
	ARSENIC	11.69	NT	NT	7.22	6.78
	BARIUM	247.1	NT	NT	87.9	50.2
	CALCIUM	114483	NT	NT	98000	130000*
	CHROMIUM	20.62	NT	NT	33.3*	54*
	COBALT	6.94	NT	NT	2.72	LT 2.6
	COPPER	24.72	NT	NT	10.4	6.49
	IRON	22731	NT	NT	7320	6230
	LEAD	18.23	NT	NT	16	LT 7.44
	MAGNESIUM	7061	NT	NT	8430*	10900*
	MANGANESE	698.3	NT	NT	182	140
	NICKEL	17.4	NT	NT	7.04	11.9
	POTASSIUM	6449	NT	NT	2600	1790
	SODIUM	337	NT	NT	208	146
	VANADIUM	28.39	NT	NT	13.9	17.6
	ZINC	102.8	NT	NT	31.3	22.4
SEMIVOLATILES	BENZYL ALCOHOL	N/A	NT	NT	LT 0.032	LT 0.032

Note.- All values in µg/g (equal to ppm).
ND = Analyte not detected above the MDL, the MDL is posted next to the "ND".
N/A = Not Applicable.
LT = Analyte concentration is less than CRL , the CRL is posted next to the "LT".
* = Organic analyte detected above CRL or MDL or detected inorganic analyte exceeding background.
NT = Not Tested.
(D) = Duplicate analysis.
= Analyte was detected in the associated blank in excess of the 5 or 10 times rule (as described in Section 3.1.1.1).



PPB-94-03	0.5'	5.0'	11.0'
Cr	26.7	*	35.4
Pb	18.9	*	*
BZALC	0.072	0.069	LT

PPB-94-01	0.5'	5.0'	11.0'
Cr	34.8	38.3	40.2
Pb	27.7	*	*

PPS-94-05	0.5'
As	16.1
Cd	4.01
Cu	26.2
Pb	70.6
BZALC	0.048
FANT	0.047

PPB-94-08	0.5'	5.0'	13.0'
Cr	23.8	33.3	54.0
Pb	23.7	*	*
DNBP	LT	LT	1.8

Figure 4-5. SWMU 32 Phase II Results

Chromium concentrations appear to increase with depth, and the highest concentration (54 $\mu g/g$) was detected in a soil sample collected from a boring location along the southeastern border of the sampling area (PPB-94-08). On the basis of this analytical data, the soil-boring and surface-soil sample locations do not appear to define the lateral or vertical extent of metals that exceed background. The increase in metals concentrations with depth could not be attributed solely to changes in lithology (e.g., a higher percentage of clay that may adsorb higher concentrations of chromium or other metals). The source of these metals is unknown.

Three SVOCs (benzyl alcohol, di-n-butyl phthalate, and fluoranthene) along with several unknown SVOCs were identified in the soil samples collected at this site. The unknown SVOCs were typically compounds associated with the alcohol and alkene groups.

Similar to the metal contaminants, the lateral and vertical extent of the detected SVOCs does not appear to be defined in the area covered by the sampling locations. Corresponding QC samples suggest these compounds are not laboratory contaminants; however, these three SVOCs were detected in low concentrations.

4.2.4 Human Health Risk Assessment

As part of the Phase II RI, an RA was conducted to estimate potential human health risks associated with the no-action alternative for SWMU 32, the PCB Spill Site. The following tasks were completed in the RA:

- Data analysis and selection of COPCs
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Conclusions and recommendations

This section provides a summary of the quantitative process employed at SWMU 32 and the results of that process. The RA for SWMU 32 is based on the methodology described in Section 3.1 and supported by Appendices L, M, N, and O.

4.2.4.1 *Selection of the Chemicals of Potential Concern - Soils*

As detailed in USEPA Region VIII guidance, a screening procedure can be used to narrow the list of contaminants at a particular site to a subset of analytes that can be considered the COPCs for the area. This screening procedure can involve up to four steps, depending on the contaminants present:

- Group data by chemical class (e.g., carcinogenic PAHs)
- Evaluate frequency of detection

- Evaluate essential nutrients
- Compare site data to risk-based screening concentrations (Region III values)

Below is the screening analysis for SWMU 32.

4.2.4.1.1 ***Data Grouping.*** No data grouping was necessary as part of COPC selection at SWMU 32.

4.2.4.1.2 ***Frequency of Detection.*** No evaluation of detection frequency was undertaken at this SWMU due to the small sample size.

4.2.4.1.3 ***Nutrient Screening.*** Magnesium and sodium were the only nutrient chemicals detected above background in surface soil. The maximum concentration of each of these nutrients was less than their respective nutrient screening values: magnesium (maximum—10,100 μg/g, screening value—1,000,000 μg/g); sodium (maximum—347 μg/g, screening value—1,000,000 μg/g). Therefore, these nutrient chemicals were eliminated as COPCs in surface soil at SWMU 32.

Calcium and magnesium were detected above background in subsurface soil. The maximum concentration of each of these nutrients was less than their respective nutrient screening values: calcium (maximum—140,000 μg/g; screening value—1,000,000 μg/g); magnesium (maximum—10,900 μg/g; screening value—1,000,000 μg/g). Calcium and magnesium were, therefore, eliminated as COPCs in subsurface soil at this site.

4.2.4.1.4 ***Region III RBC Screening.*** The final step in the COPC selection process consisted of comparing the EPCs for remaining contaminants in surface and subsurface soil with USEPA Region III RBCs. However, before these comparisons were made, a "hot spot" analysis was conducted.

For the final selection of COPCs, the site was evaluated for possible "hot spots." Since this site was smaller than a residential lot, all samples were combined to calculate the EPCs. Table 4-17 provides a summary of the EPCs for preliminary COPCs in surface soil at SWMU 32.

To select COPCs for the soil-related exposure pathways, the EPCs for the SWMU in surface and subsurface soil were compared to Region III soil ingestion and soil-to-air RBCs. As shown in Table 4-18, arsenic and cadmium were selected as COPCs for this SWMU in surface soil. Chromium was the only COPC retained for subsurface soil.

Table 4-17. Summary of Preliminary Chemicals of Potential Concern (SWMU 32)

Chemical	Frequency of Detection[a]	Range of Detected Values (μg/g)	Range of Reporting Limits (μg/g)	Arithmetic Mean Concentration (μg/g)	95% UCL Concentration (μg/g)	Exposure Point Concentration[b] (μg/g)
Surface Soil						
Arsenic	4/4	7.21 - 16.1	NA[c]	10.4	21.2	16.1
Cadmium	1/4	4.01	0.32 - 1.20	1.33	58.7	4.01
Chromium	4/4	19.7 - 34.8	NA	26.3	38.7	34.8
Copper	4/4	14.6 - 26.2	NA	19.4	29.4	26.2
Lead	4/4	18.9 - 70.6	NA	34.6	148	70.6
Benzyl alcohol	2/4	0.048 - 0.072	0.03 - 0.32	0.038	0.457	0.072
Fluoranthene	1/4	0.047	0.03 - 0.32	0.023	0.090	0.047
Subsurface Soil						
Chromium	6/6	18.1 - 54.0	NA	36.9	54.9	54.0
Benzyl alcohol	1/6	0.069	0.03 - 0.32	0.024	0.053	0.053
Di-n-butyl phthalate	1/6	1.80	0.32 - 1.30	0.830	1.37	1.37

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (USEPA, 1989).
[c]Not applicable.

Table 4-18. Selection of Chemicals of Potential Concern for Soil-related Pathways Based on EPA Region III's Soil Screening Guidance (SWMU 32)

	EPA[a] Region III RBC[b] Screen			
	Residential RBCs (μg/g)[c]			
Chemical	**Ingestion**	**Inhalation**	**Exposure Point Conc. (μg/g)**	**Retained as COPC[d]?**
Surface Soil				
Arsenic	0.37	380	16.1	**YES**
Cadmium	3.9	920	4.01	**YES**
Chromium	39.0	140	34.8	No
Copper	310	NA[e]	26.2	No
Lead	400[f]	NA	70.6	No
Benzyl alcohol	2,300	NA	0.072	No
Fluoranthene	310	6.8	0.047	No
Subsurface Soil				
Chromium	39.0	140	54.0	**YES**
Benzyl alcohol	2,300	NA	0.053	No
Di-n-butyl phthalate	780	10	1.37	No

Note.—RBCs were taken directly from the Region III RBC Table (USEPA 1995), except as noted in the footnotes. Values for noncarcinogens are 1/10 of the Region III RBC.

[a]U.S. Environmental Protection Agency.

[b]Risk-based concentration.

[c]Micrograms per gram.

[d]Chemicals of potential concern.

[e]Not applicable.

[f]OSWER recommended clean-up level for lead in residential soil (USEPA 1994).

4.2.4.2 *Selection of Chemicals of Potential Concern-Air*

For all receptors with the exception of the construction worker, the air pathway (i.e., inhalation of particulates) is evaluated on a SWMU-wide basis rather than by area of concern. Because all COPCs in soils were either metals or semi-volatile organics with very low volatility, potential exposures to wind-blown particulate would be contributed to by the entire SWMU (as well as exposed soil outside the defined SWMU), regardless of the specific SWMU-related activity. This was also assumed for potential off-site receptors. Air emissions of SWMU-related chemicals were assumed to occur by entrainment from wind erosion of particulate-bound COPCs. With entrainment, it is assumed that small amounts of the organic compounds or heavy metals become airborne and adsorbed onto the surface of dust particles.

A volatilization emission analysis was performed (SEC Donahue 1992b) using a volatilization release estimation equation designed for chemicals spilled or incorporated into soils (USEPA 1988a). Results from this analysis indicated negligible air quality impacts derived from volatilization releases from SWMUs located at TEAD. In addition, results from previous modeling conducted for adjacent sites with similar VOC concentrations revealed insignificant releases (SEC Donahue 1992b).

For current and future on-site receptors, COPCs retained for the soil pathways were used to evaluate exposures from air. For current off-site receptors, exposure point concentrations generated for COPCs retained for the on-site soil pathways were modeled using SCREEN2 to estimate the air quality impacts at selected sites surrounding TEAD. To maintain a health-protective approach, the RME EPC for children was used as the input soil concentration to the model. Off-site air concentrations generated by the model were screened against USEPA Region III Risk-Based Concentrations guidance to verify the negligible contribution of this pathway. SCREEN2 is a single-source, screening-level model that has algorithms to estimate air quality impacts associated with air sources. For a complete description of the SCREEN2 model and associated results, see Appendix N. As shown in Table 4-19, based on comparison to air RBC, no COPCs were retained for quantitative off-site evaluation.

4.2.4.3 *Selection of Chemicals of Potential Concern - Groundwater*

The selection of COPCs for the groundwater exposure pathways consist of a two-phase modeling approach. Initially, the *maximum* concentration of each analyte detected in either surface or subsurface soil was compared to the Region III soil-to-groundwater RBC. One-tenth of the value was used for noncarcinogens. If the maximum concentration of a chemical exceeded the soil-to-groundwater RBC, the chemical was selected for vadose zone modeling (Table 4-20). The modeled break-through concentration in groundwater for these chemicals was then compared to the Region III tap water RBCs, with one-tenth of the value used for noncarcinogens. In addition, the modeled break-through time was compared to the 100-year cut-off period as described in Section 2.7.2. A chemical that reached the water table within 100 years *and* had a modeled break-through concentration that exceeded the Region III tap water RBC (one-tenth of the value for noncarcinogens) was retained for further vadose-

Table 4-19. Selection of Chemicals of Potential Concern for Off-site Air-related Pathways Based on EPA Region III's Risk-Based Concentration Screening Guidance (SWMU 32)

		EPA Region III Risk-Based Concentration[a] Screen ($\mu g/m^3$)[b]					
Chemical	RME SWMU-wide Soil Exposure Point Conc. (mg/kg)[c]	Exposure Point Conc. at Property Line	Exposure Point Conc. at Grantsville	Exposure Point Conc. at Tooele	Exposure Point Conc. at Stockton	Ambient Air RBC	Retained as off-site COPC[d]?
Arsenic	16.1	0.0000018	0.00000015	0.0000014	0.00000014	0.00041	No
Barium	4.01	0.00000045	0.000000038	0.00000036	0.000000034	0.052	No

[a]Values for noncarcinogens are 1/10th of the Region III RBC (USEPA 1996).
[b]Micrograms per cubic meter.
[c]Milligrams per kilogram.
[d]Chemicals of potential concern.

Table 4-20. Selection of COPCs for Groundwater Exposure Pathways (SMWU 32)

Chemical	Maximum Above Background ($\mu g/g$)[a]	Depth[b]	Soil-to-GW RBC[b] ($\mu g/g$)	Selected for Vadose Zone Modeling?	Reached the Water Table Within 100 Years	Model Output: Break-through Point Concentration in Groundwater (mg/L)[c]	Tap Water RBC (mg/L)	Selected as COPC[d] for Groundwater[e]?
Arsenic	16.1	Surface	15	YES	No	---[f]	---	No
Cadmium	4.01	Surface	0.6	YES	---	---	---	---
Chromium	54	Subsurface	1.9	YES	No	---	---	No
Copper	26.2	Surface	31[g]	No	No	---	---	No
Lead	70.6	Surface	15[g]	YES	No	---	---	No
Benzyl alcohol	0.072	Surface	2.5[g]	No	---	---	---	---
Di-n-butyl phthalate	1.80	Subsurface	12.0	No	---	---	---	---
Fluoranthene	0.047	Surface	98.0	No	---	---	---	---

Note.—RBCs were taken directly from the Region III RBC Table except as indicated in the footnotes.
[a]Micrograms per gram.
[b]Risk-based calculations.
[c]Milligrams per liter; values taken from Table 4-20.
[d]Chemicals of potential concern.
[e]Eliminated as a groundwater COPC if the chemical reached the water table in more than 100 years or did not exceed the tap water RBC.
[f]Not applicable; not modeled, or vadose zone modeling showed that the chemical break-through time to the water table is greater than 100 years.
[g]Calculated according to Region III guidance (USEPA 1995). Action level for lead (USEPA 1995)

saturated zone modeling to on- and off-site hypothetical receptors as described in Section 2.7.2. For this second phase of modeling, the *average* surface and subsurface soil concentration was used to calculate the initial pore water concentration at the site. Again, the vadose-saturated zone modeling results were compared to the Region III tap water RBCs, with one-tenth for noncarcinogens. If the chemical still failed to meet the 100-year break-through criteria *and* exceeded the Region III tap water RBC, it was retained for quantitative risk assessment. As shown in Table 4-20, arsenic, chromium, cadmium, and lead were retained for vadose zone modeling at SWMU 32.

4.2.4.3.1 ***Vadose Zone Model Results.*** The soil screening described in the previous sections indicated that four COPCs should be evaluated using the soil-vadose-zone-groundwater screening model at SWMU 32. These COPCs consist of the four metals indicated in Table 4-20. The vadose modeling set-up procedures are described in detail in Section 2.7.2 of this report. This section defines the site-specific parameters and presents the vadose zone modeling results.

The SWMU 32 site-specific input parameters are defined as the vadose zone thickness (H cm), the area of contamination (CA m^2), and the thickness of the contaminated zone (H cont, cm). These input parameters, along with the COPC chemical-specific parameters are used as the input for the GWM-1 and MULTIMED models. The GWM-1 spreadsheets for SWMU 32 are shown in Appendix K. As indicated in Appendix K, the above site-specific input parameters for SWMU 32 are as follows:

H = 9,906 cm

CA = 232 m^2

H cont = 305 cm

Other key COPC specific parameters—the distribution coefficient (Kd), the maximum observed soil concentration (Tc), the initial pore water concentration (C_{init}), and the plume pulse duration (p.d.)—are also shown in Appendix K. All of the GWM-1 spreadsheets associated with the SWMU-specific COPCs are in Appendix K along with the MULTIMED output concentrations. Table 4-21 summarizes these COPC-specific parameters and shows the MULTIMED output for COPC break-through time (time after leaching starts, that the leading edge of the COPC plume reaches the top of the water table) along with the COPC estimated concentration at the time that breakthrough occurs. One key to interpreting these estimates is that the pore water concentration was determined by starting with the maximum observed soil concentration measured at the site (see Table 4-20) and calculating the maximum concentration available for the pore water solution by soil-water partitioning. As explained in Section 2.7.2, the equation used is very dependent on Kd and does not take into account mineral solubility and equilibrium relationships. This is evident by some of the high C_{init} concentrations estimated for several of the COPCs.

4.2.4.3.2 ***Groundwater COPCs.*** As shown in Table 4-21, the MULTIMED output indicates that within a 100-year time period no metals will travel downward through the vadose zone and reach the water table. As discussed in detail in Section 2.7.2, the conservative approach was the bases for the model calculations.

Table 4-21. Summary of Break-through Vadose Zone Modeling Results and Critical I/O GWM-1 and MULTIMED Parameters for SWMU 32

	COPC Specific Parameters					
Analyte	**Kd[a]**	**Tc (max)[b] (ppm)**	**C_{leak}[c] (mg/L)**	**Breakthrough Time (yrs)**	**Breakthrough Conc. (mg/L)**	**p.d.[d] (yrs)**
Arsenic	1	16.1	16.1	825	0.073	58
Chromium	1.2	54	45.8	975	0.194	69
Cadmium	1.3	4.01	3.16	1,050	0.188	74
Lead	4.5	70.6	17	3,500	0.093	242

Note.—Site-specific parameters are as follows: vadose zone thickness (h) = 9,906; area of contaminated soil (CA) = 232 m^2; thickness of contaminated soil (Hcont) = 305 cm.

[a]The distribution coefficient and is dimensionless.

[b]The maximum observed soil concentration (ppm).

[c]The pore water concentration at the source as conservatively calculated by GWM-1.

[d]The pulse duration as calculated by GWM-1.

Table 4-21 illustrates this concept, showing the critical input and output parameters and the estimated breakthrough time for each COPC. This table also shows the estimated concentration associated with the arrival of leading edge of the COPC plume at the water table. Again, it should be noted that the break-through time calculation does not take into account the various retardation influences, such as biodegradation, volatilization, absorption, adsorption, and mineral-solution equilibrium relationships.

In summary, arsenic calculations indicate a break-through time of 825 years at a concentration of 0.073 mg/L. All other COPCs reach the water table at some time after 825 years as indicated in Table 4-21. Therefore, no groundwater COPCs for SWMU 32 were considered in the quantitative risk assessment.

4.2.4.4 *Exposure Assessment*

Exposure is defined as the contact of a receptor with a chemical (USEPA 1989c). Exposure assessment is the estimation of the magnitude, frequency, and duration for each identified route of exposure. The magnitude of an exposure is determined by estimating the amount of chemical available at the receptor exchange boundaries (i.e., lungs, gastrointestinal tract, or skin) during a specified time period.

Section 3.1.2 describes the general tasks comprising the exposure assessment. The specific application of these tasks to SWMU 32 is described below.

4.2.4.4.1 *Characterization of Exposure Setting*. The first step in developing exposure scenarios for SWMU 32 was to characterize the site setting in which potential exposures might occur. The characteristics of the site setting influence the types of transport mechanisms and the type of receptor exposure that could occur. The site setting also provides a basis for identifying the potential receptors (either real or, in the case of site redevelopment for alternative use, hypothetical). Both current land use patterns and future land use patterns were examined as part of the characterization.

Current Land Use. SWMU 32 is located in the eastern industrial portion of TEAD (maintenance area), which is part of the BRAC parcel scheduled to be transferred to the TCEDC. To date, several buildings in the BRAC parcel have been leased to private business and access is no longer controlled. For the open lots, including SWMU 32, no activities are being conducted and transient exposure to the public is expected to be minimal.

Based on the above information, potential receptors under current land use were defined as:

- Depot staff—Primarily military and civilian office staff in the main depot complex.
- SWMU-specific laborers and security personnel—Individuals with job descriptions that call for repeated, moderate to heavy labor in the general vicinity of SWMU 32 and staff assigned to maintenance of the SWMU perimeter or security personnel that repeatedly work in the vicinity of SWMU 32.

Because other potential receptors would be exposed only intermittently to SWMU 32, SWMU-specific laborers and security personnel were the only receptors evaluated quantitatively as a current-use scenario. This approach provides a series of upper-bound estimates.

Future Land Use. Under the current BRAC plan, 1,700 acres comprising the maintenance and administrative areas of the depot were scheduled to be turned over to the TCEDC in 1995 through an interim lease (HOH Associates 1995). To date, none of the 1,700 acres have been turned over. The Tooele County EDA is in the process of preparing an application for an EDC of the entire 1,700-acre parcel. In the interim, the Army is pursuing the interim lease of a number of facilities in cooperation with the EDA. To date, several buildings have been leased and several other leases are pending. The open lots, however, remain empty and unused.

Based on this information, some exposure scenarios that are analogous to current-use scenarios described above will continue (i.e., depot staff). However, two additional exposure scenarios unique to planned or potential future use of SWMU 32 were developed:

- Skilled laborers—Individuals assigned to short-term construction in the vicinity of SWMU 32 during potential redevelopment.

- Inhabitants of an on-site residence(s)—Individuals who live in residences established at the time that depot property should ever be transferred for redevelopment.

4.2.4.4.2 *Characterization of Potential Exposure Pathways*. An exposure pathway is the route COPCs take to reach potential receptors. Sections 3.1.2.1 and 3.1.2.2 describe the methodology for characterization of exposure pathways. This methodology was applied to SWMU 32. The following sections describe the potential exposure pathways associated with SWMU 32 for the current and future land use scenarios.

Current Land Use. Currently, the majority of laborers at TEAD work 10-hour days with 4-day weeks. Assuming a total of 4 weeks off a year for vacation, holidays, and sick leave, this yields 192 days per year on the job. It is assumed that a laborer could be at any specific SWMU from 2 to 10 hours per day and will inhale particulates generated from surface soil through work-related activities. Military personnel are rotated on assignment an average of every 3 years (S. Culley, personal communication with Rust E&I, 1994). If a laborer is a civilian, the length of assignment could be expected to range as high as 25 years. It is assumed that all of the exposure is from outdoor tasks or activities. Specific parameters relating to ingestion, contact, ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

Future Land Use. Under the current BRAC plan, SWMU 32, located in the maintenance area, is slated for industrial use/redevelopment. Based on this assumption, the skilled workers and potential on-site residents are evaluated for future use scenarios. Future SWMU 32 staff, such as laborers and security personnel, are covered under the current land use scenario described above.

For the future on-site adult resident, it was assumed that at least one parent would spend much of his or her time away from home in activities such as working at another location, household errands, personal care (e.g., medical/dental appointments), or leisure activities. Based on this assumption, the total estimated time an adult will spend at home is approximately 15 to 19 hours per day during which time he or she may incidentally ingest, inhale, or come in contact with surface soil while conducting activities such as gardening, mowing, or outdoor sports. It is also expected that the future on-site resident will grow and harvest vegetables and fruits from a home garden. For children and adolescents ages 0 to 18, time activity patterns indicate that they spend an average of approximately 30 hours per week away from home to attend school or day care. The total time a child spends at home, averaged over a 7-day week, is approximately 20 hours per day. It is assumed that residents spend 2 (RME) to 4 (CTE) weeks away from home on vacation or long holiday weekends. Therefore, the exposure frequency in real time is 335 days per year (CTE) to 350 days per year (RME). Because the contact rate for ingestion and dermal exposure is in daily units, the exposure frequency for these pathways is prorated into 24-hour-day equivalents. This ranges from 216 days per year (CTE adult) to 276 days per year (CTE child) and from 273 days per year (RME adult) to 288

days per year (RME child) (see Appendix L). Years spent at one residence for the adult/child range from 8 (CTE) to 30 (RME) years based on studies compiled by the USEPA (1989c) and AIHC (1994). Specific parameters relating to ingestion, contact, ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

Based on the proposed continued industrial future usage of SWMU 32, it is possible that industrial construction may be conducted. For these reasons, the future construction worker scenario was evaluated. It is assumed that a construction company could be contracted for a work period ranging from 1 to 3 years and a single worker could be at the site conducting activities outdoors from 2 to 4 months of the year. It is assumed that a worker works as much as 8 to 10 hours per day and may incidentally ingest, inhale, or come in contact with subsurface soil through construction-related activities. Specific parameters relating to ingestion, contact, ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

4.2.4.5 *Exposure Point Concentrations*

The EPC is defined as the concentration of a COPC in an exposure medium that will be contacted over a real or hypothetical exposure duration. The EPCs for arsenic at SWMU 32 were evaluated for current and future use. The general methodology for estimation of EPCs is described in Appendix L.

Current Land Use. EPCs for surface soil ingestion and dermal contact by the SWMU 32 personnel were estimated for the CTE and RME scenarios with data from Phase II Remedial Investigation data.

EPCs in air for on-site personnel were estimated using USEPA's SCREEN2 model. Details of the estimation of emission rates from surface soils and dispersion modeling are described in Appendix N. Table 4-22 presents the EPCs for on-site personnel at SWMU 32.

Future Land Use. EPCs for subsurface soil ingestion and dermal contact by hypothetical future on-site construction workers at SWMU 32 were estimated using the same methods as those used for the on-site personnel under the current land use scenario. EPCs for inhalation of particulates were modeled, as described in Appendix N, for the hypothetical on-site construction worker and resident (see Appendix L). EPCs for surface soil ingestion, dermal contact, and produce ingestion by hypothetical future on-site residents at SWMU 32 were estimated using methods described in Appendix L. The EPCs for surface and subsurface soils are given in Tables 4-22 and 4-23.

4.2.4.5.1 ***Estimation of Chemical Intakes.*** The exposure models described in detail in Appendix L and EPCs listed in Tables 4-22 and 4-23 were used to estimate intake for the potential exposure scenarios. Note that averaging time differs for carcinogens and noncarcinogens. Estimates of exposure intakes are given in Tables 4-24 through 4-31.

Table 4-22. Adult Exposure Point Concentrations for SWMU 32

Chemical	Exposure Point Concentration	
	CTE[a]	RME[b]
Current Land Use		
Surface Soil (mg/kg)		
Arsenic	16.1	16.1
Cadmium	4.0	4.0
Air Emissions (mg/m^3)		
Arsenic	0.000000069	0.000000069
Cadmium	0.000000017	0.000000017
Future Land Use [c]		
Surface Soil (mg/kg)[d]		
Air Emissions from Surface Soil (mg/m^3)[b]		
Subsurface Soil (mg/kg)		
Chromium	54.0	54.0
Air Emissions from Subsurface Soil (mg/m^3)		
Chromium	0.000018	0.000018
Tubers/Fruits (mg/kg)		
Arsenic	0.0068	0.0068
Cadmium	0.042	0.042
Leafy Vegetables (mg/kg)		
Arsenic	0.045	0.045
Cadmium	0.15	0.15

[a]Central tendency exposure.
[b]Reasonable maximum exposure.
[c]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.
[d]Future use concentrations are the same as for the current use scenarios.

Table 4-23. Child Exposure Point Concentrations for SWMU 32

Chemical	Exposure Point Concentration CTE[a]	RME[b]
Future Land Use [c]		
Surface Soil (mg/kg)		
Arsenic	16.1	16.1
Cadmium	4.0	4.0
Air Emissions (mg/m^3)		
Arsenic	0.000000069	0.000000069
Cadmium	0.000000017	0.000000017
Tubers/Fruits (mg/kg)		
Arsenic	0.0068	0.0068
Cadmium	0.042	0.042
Leafy Vegetables (mg/kg)		
Arsenic	0.045	0.045
Cadmium	0.15	0.15

[a]Central tendency exposure.
[b]Reasonable maximum exposure.
[c]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.
[d]Future use concentrations are the same as for the current use scenarios.

Table 4-24. Summary of Potential Carcinogenic Risk Results for the Current/Future On-Site Laborer for SWMU 32

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.6E+01	1.5E-09	1.5E+00	2.3E-09	
Cadmium	4.0E+00	NA[d]	NA	NA	
			Pathway Total:	2.3E-09	93%
Dermal Contact with Surface Soil					
Arsenic	1.6E+01	7.7E-11	1.5E+00	1.2E-10	
Cadmium	4.0E+00	NA	NA	NA	
			Pathway Total:	1.2E-10	5%
Inhalation of Particulates					
Arsenic	6.9E-08	3.1E-12	1.5E+01	4.7E-11	
Cadmium	1.7E-08	7.8E-13	6.3E+00	4.9E-12	
			Pathway Total:	5.2E-11	2%
			Total CTE ILCR:	2.5E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.6E+01	1.2E-06	1.5E+00	1.8E-06	
Cadmium	4.0E+00	NA	NA	NA	
			Pathway Total:	1.8E-06	89%
Dermal Contact with Surface Soil					
Arsenic	1.6E+01	1.4E-07	1.5E+00	2.2E-07	
Cadmium	4.0E+00	NA	NA	NA	
			Pathway Total:	2.2E-07	11%
Inhalation of Particulates					
Arsenic	6.9E-08	7.5E-10	1.5E+01	1.1E-08	
Cadmium	1.7E-08	1.9E-10	6.3E+00	1.2E-09	
			Pathway Total:	1.3E-08	1%
			Total RME ILCR:	2.1E-06	100%

[a]Units for the inhalation pathway are mg/m3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 4-25. Summary of Potential Carcinogenic Risk Results for the Future On-Site Adult Resident for SWMU 32

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.6E+01	1.4E-07	1.5E+00	2.1E-07	
Cadmium	4.0E+00	NA[d]	NA	NA	
			Pathway Total:	2.1E-07	12%
Dermal Contact with Surface Soil					
Arsenic	1.6E+01	7.1E-09	1.5E+00	1.1E-08	
Cadmium	4.0E+00	NA	NA	NA	
			Pathway Total:	1.1E-08	1%
Inhalation of Particulates					
Arsenic	6.9E-08	2.5E-10	1.5E+01	3.7E-09	
Cadmium	1.7E-08	6.2E-11	6.3E+00	3.9E-10	
			Pathway Total:	4.1E-09	0%
Ingestion of Leafy Vegetables					
Arsenic	4.5E-02	6.7E-07	1.5E+00	1.0E-06	
Cadmium	1.5E-01	NA	NA	NA	
			Pathway Total:	1.0E-06	58%
Ingestion of Tubers and Fruits					
Arsenic	6.8E-03	3.4E-07	1.5E+00	5.1E-07	
Cadmium	4.2E-02	NA	NA	NA	
			Pathway Total:	5.1E-07	29%
			Total CTE ILCR:	1.7E-06	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.6E+01	3.3E-06	1.5E+00	5.0E-06	
Cadmium	4.0E+00	NA	NA	NA	
			Pathway Total:	5.0E-06	20%
Dermal Contact with Surface Soil					
Arsenic	1.6E+01	3.9E-07	1.5E+00	6.0E-07	
Cadmium	4.0E+00	NA	NA	NA	
			Pathway Total:	6.0E-07	2%
Inhalation of Particulates					
Arsenic	6.9E-08	1.3E-09	1.5E+01	2.0E-08	
Cadmium	1.7E-08	3.3E-10	6.3E+00	2.1E-09	
			Pathway Total:	2.2E-08	0%
Ingestion of Leafy Vegetables					
Arsenic	4.5E-02	8.8E-06	1.5E+00	1.3E-05	
Cadmium	1.5E-01	NA	NA	NA	
			Pathway Total:	1.3E-05	52%
Ingestion of Tubers and Fruits					
Arsenic	6.8E-03	4.5E-06	1.5E+00	6.7E-06	
Cadmium	4.2E-02	NA	NA	NA	
			Pathway Total:	6.7E-06	26%
			Total RME ILCR:	2.6E-05	100%

[a]Units for the inhalation pathway are mg/m3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.
they are not classified as carcinogens.

Table 4-26. Summary of Potential Carcinogenic Risk Results for the Future On-Site Child Resident for SWMU 32

Chemical	Exposure Point Concentration (mg/kg)[(a)]	Daily Carcinogenic Intake[(b)] (mg/kg-day)	Carcinogenic Slope Factor[(c)] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.6E+01	6.4E-07	1.5E+00	9.6E-07	
Cadmium	4.0E+00	NA[(d)]	NA	NA	
			Pathway Total:	9.6E-07	28%
Dermal Contact with Surface Soil					
Arsenic	1.6E+01	1.2E-08	1.5E+00	1.8E-08	
Cadmium	4.0E+00	NA	NA	NA	
			Pathway Total:	1.8E-08	1%
Inhalation of Particulates					
Arsenic	6.9E-08	1.3E-09	1.5E+01	1.9E-08	
Cadmium	1.7E-08	3.2E-10	6.3E+00	2.0E-09	
			Pathway Total:	2.1E-08	1%
Ingestion of Leafy Vegetables					
Arsenic	4.5E-02	1.1E-06	1.5E+00	1.6E-06	
Cadmium	1.5E-01	NA	NA	NA	
			Pathway Total:	1.6E-06	47%
Ingestion of Tubers and Fruits					
Arsenic	6.8E-03	5.5E-07	1.5E+00	8.3E-07	
Cadmium	4.2E-02	NA	NA	NA	
			Pathway Total:	8.3E-07	24%
			Total CTE ILCR:	3.5E-06	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.6E+01	7.1E-06	1.5E+00	1.1E-05	
Cadmium	4.0E+00	NA	NA	NA	
			Pathway Total:	1.1E-05	44%
Dermal Contact with Surface Soil					
Arsenic	1.6E+01	1.6E-07	1.5E+00	2.5E-07	
Cadmium	4.0E+00	NA	NA	NA	
			Pathway Total:	2.5E-07	1%
Inhalation of Particulates					
Arsenic	6.9E-08	2.1E-09	1.5E+01	3.1E-08	
Cadmium	1.7E-08	5.2E-10	6.3E+00	3.3E-09	
			Pathway Total:	3.4E-08	0%
Ingestion of Leafy Vegetables					
Arsenic	4.5E-02	5.8E-06	1.5E+00	8.7E-06	
Cadmium	1.5E-01	NA	NA	NA	
			Pathway Total:	8.7E-06	36%
Ingestion of Tubers and Fruits					
Arsenic	6.8E-03	2.9E-06	1.5E+00	4.4E-06	
Cadmium	4.2E-02	NA	NA	NA	
			Pathway Total:	4.4E-06	18%
			Total RME ILCR:	2.4E-05	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 4-27. Summary of Potential Carcinogenic Risk Results for the Future Construction Worker for SWMU 32

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Subsurface Soil					
Chromium	5.4E+01	NA(d)	NA	NA	
				NA	NA
Dermal Contact with Subsurface Soil					
Chromium	5.4E+01	NA	NA	NA	
				NA	NA
Inhalation of Particulates					
Chromium	1.8E-05	1.7E-09	4.2E+01	7.2E-08	
			Pathway Total:	7.2E-08	100%
			Total CTE ILCR:	7.2E-08	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Subsurface Soil					
Chromium	5.4E+01	NA	NA	NA	
				NA	NA
Dermal Contact with Subsurface Soil					
Chromium	5.4E+01	NA	NA	NA	
				NA	NA
Inhalation of Particulates					
Chromium	1.8E-05	2.3E-08	4.2E+01	9.5E-07	
			Pathway Total:	9.5E-07	100%
			Total RME ILCR:	9.5E-07	100%

[a]Units for the inhalation pathway are mg/m3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 4-28. Summary of Potential Systemic Effects for the Current/Future On-Site Laborer for SWMU 32

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.6E+01	3.8E-08	3.0E-04	1.3E-04	
Cadmium	3.9E+00	9.3E-09	1.0E-03	9.3E-06	
			Pathway Total:	1.4E-04	91%
Dermal Contact with Surface Soil					
Arsenic	1.6E+01	1.9E-09	2.9E-04	6.5E-06	
Cadmium	3.9E+00	4.6E-10	6.0E-05	7.7E-06	
			Pathway Total:	1.4E-05	9%
Inhalation of Particulates					
Arsenic	6.9E-08	NA[d]	NA	NA	
Cadmium	1.7E-08	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	1.5E-04	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.6E+01	3.7E-06	3.0E-04	1.2E-02	
Cadmium	3.9E+00	8.9E-07	1.0E-03	8.9E-04	
			Pathway Total:	1.3E-02	81%
Dermal Contact with Surface Soil					
Arsenic	1.6E+01	4.3E-07	2.9E-04	1.5E-03	
Cadmium	3.9E+00	1.0E-07	6.0E-05	1.7E-03	
			Pathway Total:	3.2E-03	19%
Inhalation of Particulates					
Arsenic	6.9E-08	NA	NA	NA	
Cadmium	1.7E-08	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	1.6E-02	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 4-29. Summary of Potential Systemic Effects for the Future On-Site Adult Resident for SWMU 32

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.6E+01	1.3E-06	3.0E-04	4.4E-03	
Cadmium	4.0E+00	3.3E-07	1.0E-03	3.3E-04	
			Pathway Total:	4.7E-03	6%
Dermal Contact with Surface Soil					
Arsenic	1.6E+01	6.6E-08	2.9E-04	2.3E-04	
Cadmium	4.0E+00	1.6E-08	6.0E-05	2.7E-04	
			Pathway Total:	5.0E-04	1%
Inhalation of Particulates					
Arsenic	6.9E-08	NA[d]	NA	NA	
Cadmium	1.7E-08	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Arsenic	4.5E-02	6.3E-06	3.0E-04	2.1E-02	
Cadmium	1.5E-01	2.1E-05	1.0E-03	2.1E-02	
			Pathway Total:	4.2E-02	54%
Ingestion of Tubers and Fruits					
Arsenic	6.8E-03	3.2E-06	3.0E-04	1.1E-02	
Cadmium	4.2E-02	2.0E-05	1.0E-03	2.0E-02	
			Pathway Total:	3.0E-02	39%
			Total CTE HI:	7.8E-02	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.6E+01	8.4E-06	3.0E-04	2.8E-02	
Cadmium	4.0E+00	2.1E-06	1.0E-03	2.1E-03	
			Pathway Total:	3.0E-02	10%
Dermal Contact with Surface Soil					
Arsenic	1.6E+01	9.7E-07	2.9E-04	3.3E-03	
Cadmium	4.0E+00	2.4E-07	6.0E-05	4.0E-03	
			Pathway Total:	7.3E-03	3%
Inhalation of Particulates					
Arsenic	6.9E-08	NA	NA	NA	
Cadmium	1.7E-08	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Arsenic	4.5E-02	2.2E-05	3.0E-04	7.4E-02	
Cadmium	1.5E-01	7.4E-05	1.0E-03	7.4E-02	
			Pathway Total:	1.5E-01	51%
Ingestion of Tubers and Fruits					
Arsenic	6.8E-03	1.1E-05	3.0E-04	3.7E-02	
Cadmium	4.2E-02	6.9E-05	1.0E-03	6.9E-02	
			Pathway Total:	1.1E-01	37%
			Total RME HI:	2.9E-01	100%

[a]Units for the inhalation pathway are mg/m3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 4-30. Summary of Potential Systemic Effects for the Future On-Site Child Resident for SWMU 32

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.6E+01	6.0E-06	3.0E-04	2.0E-02	
Cadmium	4.0E+00	1.5E-06	1.0E-03	1.5E-03	
			Pathway Total:	2.1E-02	15%
Dermal Contact with Surface Soil					
Arsenic	1.6E+01	1.1E-07	2.9E-04	3.8E-04	
Cadmium	4.0E+00	2.8E-08	6.0E-05	4.6E-04	
			Pathway Total:	8.4E-04	1%
Inhalation of Particulates					
Arsenic	6.9E-08	NA[d]	NA	NA	
Cadmium	1.7E-08	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Arsenic	4.5E-02	1.0E-05	3.0E-04	3.4E-02	
Cadmium	1.5E-01	3.4E-05	1.0E-03	3.4E-02	
			Pathway Total:	6.8E-02	49%
Ingestion of Tubers and Fruits					
Arsenic	6.8E-03	5.2E-06	3.0E-04	1.7E-02	
Cadmium	4.2E-02	3.2E-05	1.0E-03	3.2E-02	
			Pathway Total:	4.9E-02	35%
			Total CTE HI:	1.4E-01	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.6E+01	3.0E-05	3.0E-04	9.9E-02	
Cadmium	4.0E+00	7.4E-06	1.0E-03	7.4E-03	
			Pathway Total:	1.1E-01	27%
Dermal Contact with Surface Soil					
Arsenic	1.6E+01	6.8E-07	2.9E-04	2.3E-03	
Cadmium	4.0E+00	1.7E-07	6.0E-05	2.8E-03	
			Pathway Total:	5.1E-03	1%
Inhalation of Particulates					
Arsenic	6.9E-08	NA	NA	NA	
Cadmium	1.7E-08	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Arsenic	4.5E-02	2.4E-05	3.0E-04	8.0E-02	
Cadmium	1.5E-01	8.0E-05	1.0E-03	8.0E-02	
			Pathway Total:	1.6E-01	41%
Ingestion of Tubers and Fruits					
Arsenic	6.8E-03	1.2E-05	3.0E-04	4.1E-02	
Cadmium	4.2E-02	7.6E-05	1.0E-03	7.6E-02	
			Pathway Total:	1.2E-01	30%
			Total RME HI:	3.9E-01	100%

[a]Units for the inhalation pathway are mg/m3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 4-31. Summary of Potential Systemic Effects for the Future Construction Worker for SWMU 32

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Subsurface Soil					
Chromium	5.4E+01	3.0E-05	2.0E-02	1.5E-03	
			Pathway Total:	1.5E-03	93%
Dermal Contact with Subsurface Soil					
Chromium	5.4E+01	1.1E-07	1.0E-03	1.1E-04	
			Pathway Total:	1.1E-04	7%
Inhalation of Particulates					
Chromium	1.8E-05	NA[d]	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	1.6E-03	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Subsurface Soil					
Chromium	5.4E+01	1.4E-04	2.0E-02	6.9E-03	
			Pathway Total:	6.9E-03	74%
Dermal Contact with Subsurface Soil					
Chromium	5.4E+01	2.4E-06	1.0E-03	2.4E-03	
			Pathway Total:	2.4E-03	26%
Inhalation of Particulates					
Chromium	1.8E-05	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	9.4E-03	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

4.2.4.6 *Toxicity Assessment*

Information on the toxicological effects of carcinogenic and systemic toxicants are summarized in Appendix M. This toxicity assessment includes brief toxicity profiles on data listed in USEPA's IRIS database and published in HEAST (USEPA 1994c). These profiles describe the acute, chronic, and carcinogenic health effects associated with SWMU-related chemicals. Toxicity values for the COPC associated with SWMU 32 are summarized in Tables 4-24 through 4-31.

4.2.4.7 *Risk Characterization*

This section provides a characterization of the potential health risks associated with the intake of chemicals associated with SWMU 32. The risk characterizations compares estimated potential ILCRs with reasonable levels of risk for potential carcinogens (see Section 3.1.4.1), and the estimated daily intake of systemic toxicants with appropriate reference levels. Some carcinogenic chemicals may also pose a systemic hazard, and these potential hazards are characterized as for other systemic toxicants.

4.2.4.7.1 *Characterization of Potential Carcinogenic Risks*

Current On-site Laborer. The cumulative ILCR for arsenic is 2.1E-06 and 2.5E-09 for the RME and CTE scenarios, respectively, and are summarized in Table 4-24. The driving pathway is ingestion of soil which contributes greater than 88 percent of the total estimated risk.

Total ILCR for incidental ingestion of surface soil by laborers at SWMU 32 is 1.8E-06 and 2.3E-09 for the RME and CTE scenarios, respectively. Dermal contact with surface soil and inhalation of particulates by laborers do not present an individual risk above the lower bound of the target risk range. The estimated ILCRs for these pathways range from 2.2E-07 to 5.2E-11. Arsenic is the driving contributor to the estimated risk.

Future On-site Adult Resident. The cumulative ILCR for all pathways is 2.6E-05 and 1.7E-06 for the RME and CTE scenarios, respectively. As summarized in Table 4-25, the driving pathway is ingestion of produce, which contributes 78 percent of the estimated risk.

Incremental lifetime cancer risk attributed to ingestion of produce by adults, such as homegrown vegetables, results in an estimated ILCR of 2.0E-05 and 1.5E-06 using RME and CTE parameters, respectively. Ingestion of surface soil by adults during yard work, gardening, etc., results in an estimated ILCR of 5.0E-06 using RME conditions and 2.1E-07 using the CTE conditions. The ILCR for the remaining pathways evaluated—dermal contact with surface soil and inhalation of particulates—is below the target risk range for both the RME and CTE scenarios, and ranges from 6.0E-07 to 4.1E-09. Arsenic is the driving contributor to the estimated risk.

Future On-site Child Resident. The cumulative ILCR for all pathways is 2.4E-05 and 3.5E-06 for the RME and CTE scenarios, respectively. As summarized in Table 4-26, the driving pathway is ingestion of produce, which contributes greater than 44 percent of the estimated risk.

Incremental lifetime cancer risk attributed to ingestion of produce by children, such as homegrown vegetables, results in an estimated ILCR of 1.3E-05 and 2.4E-06 using RME and CTE parameters, respectively. Ingestion of surface soil by children during yard work, playing, etc., results in an estimated ILCR of 1.1E-05 using RME conditions and 9.6E-07 using the CTE conditions. The ILCR for the remaining pathways evaluated—dermal contact with surface soil and inhalation of particulates—is below the target risk range for both the RME and CTE scenarios, and ranges from 2.5E-07 to 1.8E-08. Arsenic is the driving contributor to the estimated risk.

Future Construction Worker. As summarized in Table 4-27, the cumulative ILCR for all pathways is 9.5E-07 and 7.2E-08 for the RME and CTE scenarios, respectively. The only contributing pathway is inhalation of particulates. Incremental lifetime cancer risks were not estimated for the ingestion of and dermal contact with surface soil because oral and dermal reference doses are not available for chromium at this time.

4.2.4.7.2 *Characterization of Potential Systemic Effects*

Current On-site Laborer. As summarized in Table 4-28, the summed HI for all pathways is 1.6E-02 and 1.5E-04 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of surface soil, which contributes greater than 81 percent of the total HI.

Results for the CTE and RME scenario indicate that none of the pathways evaluated—including ingestion, dermal contact, and inhalation—have HIs above unity (one). The HIs for these pathways range from 1.3E-02 to 1.4E-05.

Future On-site Adult Resident. As summarized in Table 4-29, the summed HI for all pathways is 2.9E-01 and 7.8E-02 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of produce, which contributes greater than 88 percent of the total HI.

Results of the CTE and RME scenario indicate that none of the pathways evaluated—including ingestion, dermal contact, and inhalation of surface soil and ingestion of produce—have HIs above unity (one). The HIs for these pathways range from 2.6E-01 to 5.0E-04.

Future On-site Child Resident. As summarized in Table 4-30, the summed HI for all pathways is 3.9E-01 and 1.4E-01 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of produce which contributes greater than 71 percent of the total HI.

Results of the CTE and RME scenario indicate that none of the pathways evaluated—including ingestion, dermal contact, and inhalation of surface soil and ingestion of produce—have HIs above unity (one). The HIs for these pathways range from 2.8E-01 to 8.4E-04.

Future Construction Worker. As summarized in Table 4-31, the summed HI for all pathways is 9.4E-03 and 1.6E-03 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of subsurface soil which contributes greater than 74 percent of the total HI.

4.2.4.8 *Risk Assessment Summary and Conclusions*

A baseline risk assessment addendum was conducted for the PCB Spill Site (SWMU 32) based on Phase I and Phase II RI data. Several current and future-use scenarios were quantitatively evaluated:

- On-site laborer/security worker
- Construction worker (during redevelopment)
- On-site resident (after redevelopment)

For each scenario, an RME and a CTE were evaluated. All scenarios were found to fall within or below the target ranges for tolerable ILCRs and HIs. Under the current BRAC plan, 1,700 acres comprising the maintenance and administrative areas of the depot are scheduled to be turned over to the TCEDC through an interim lease (HOH Associates 1995). The majority of the land will continue in industrial use, possibly as an addition to the Tooele Industrial Park complex. SWMU 32 is included in that portion slated for industrial use/redevelopment. Therefore, the possibility of residential development in the future is remote.

Tables 4-32 and 4-33 summarize the RME and CTE ILCRs and HIs for the current and future land use scenarios.

Based on the available analytical data and the above considerations, the risk assessment results indicate that risks to human health from the presence of low levels of hazardous chemicals at SWMU 32 are at acceptable levels when compared with risk-based criteria. No further remedial investigations based on considerations of human health are recommended for SWMU 32.

4.2.5 Conclusions and Recommendations

The Phase II RI sample analyte suite for SWMU 32 consisted of PCBs, metals, VOCs, and SVOCs. No PCBs or VOCs were detected in any of these samples. Metals were detected in both surface and subsurface soil at concentrations exceeding background and consisted of arsenic, cadmium, chromium, copper, and lead. Low concentrations of SVOCs were also detected in both surface and subsurface soil at this site.

Table 4-32. Summary of CTE Risk Results for SWMU 32

Scenario	SWMU as a Whole HI	SWMU as a Whole ILCR
Current Land Use		
On-site Laborer	1.5E-04	2.5E-09
Future Land Use		
On-site Adult Resident	7.8E-02	1.7E-06
On-site Child Resident	1.4E-01	3.5E-06
Construction Worker	1.6E-03	7.2E-08

Table 4-33. Summary of RME Risk Results for SWMU 32

Scenario	SWMU as a Whole HI	SWMU as a Whole ILCR
Current Land Use		
On-site Laborer	1.6E-02	2.1E-06
Future Land Use		
On-site Adult Resident	2.9E-01	2.6E-05
On-site Child Resident	3.9E-01	2.4E-05
Construction Worker	9.4E-03	9.50E-07

A baseline human health risk assessment was conducted at this SWMU in order to determine any potential human health or environmental risks associated with a no-action alternative. COPCs were evaluated in both surface and subsurface soil media based on Phase I and Phase II data analysis. Arsenic and cadmium in surface soils were the only COPCs retained for further evaluation based on the USEPA soil screening criteria. There were no subsurface COPCs identified with the exception of chromium. For the on-site laborer scenario, the CTE and RME were evaluated and resulted in risk estimates of 2.5E-09 CTE ILCR and 2.1E-06 RME ILCR. Chemical-specific CTE HI totaled 1.5E-04 and RME HI totaled 1.6E-02. These total risk values fall within or below the target ranges for tolerable ICLRs and HIs.

For the future on-site adult resident, the CTE and RME ILCR estimates were 1.7 E-06 and 2.6 E-05, respectively, which are within the risk-based target range. The future on-site child resident had CTE and RME ILCR estimates of 3.5E-06 and 2.4E-05, respectively, which are also within the risk-based target range. The summed HIs for the on-site adult resident were 7.8 E-02 and 2.9 E-01 for the CTE and RME, respectively. The on-site child resident had summed HIs of 1.4 E-01 and 3.9 E-01 for the CTE and RME, respectively. All HIs were below the target of unity (one).

The future construction worker had an ILCR of 7.2 E-08 and 9.5 E-07 for the CTE and RME, respectively, which are below the target range. The HIs for the construction worker were 1.6 E-03 and 9.4 E-03 for the CTE and RME, respectively, which are both below the target of unity.

Ecological risk results for SWMU 32 are presented in the TEAD SWERA report (Rust E&I 1996).

These risk assessment results indicate that risks to human health from the presence of low levels of hazardous chemicals at SWMU 32 are at acceptable levels (within or below risk-based criteria). Therefore, it is recommended that no further remedial investigations are necessary. A feasibility study will be conducted for SWMU 32, as required by CERCLA, to determine if any other remedies are required for this SWMU. Conclusions from this report and the SWERA will be used during the FS process in order to derive final recommendations for SWMU 32.

4.3 WASTEWATER SPREADING AREA (SWMU 35)

4.3.1 Site Characteristics

The Wastewater Spreading Area (SWMU 35) is located approximately 1,500 feet south of the Administration Area and 4,000 feet west-southwest of a former residential complex in the southeastern portion of TEAD (Figure 4-6). The extreme eastern portion of this SWMU is adjacent to the administrative area of the BRAC parcel. Wastewater was reportedly discharged from the former residential complex where it subsequently flowed westward through two culverts under railroad tracks into two unlined ditches, each approximately 4 to 6 feet deep (EA 1988). After crossing under the railroad tracks, the ditches cross a grassy field until they discharge into a ravine. The ravine drops 40 to 50 vertical feet and continues to the west where it discharges into a relatively flat spreading area covered with vegetation, including cottonwood trees and brush. The depth to bedrock at this site is estimated to be 1,750 feet bgs (Ertec 1982). The depth to groundwater is approximately 350 feet bgs, with groundwater flow toward the northwest.

SWMU 35 was identified during a review of historical aerial photographs from 1953, 1959, 1966, and 1981. These photographs were analyzed to determine the potential environmental impact of past installation activities (USEPA 1982). The Wastewater Spreading Area was identified from the 1953 photographs as a potential waste site because of the presence of liquids in the ditches, trenches, and ravine. The suspected source of the liquids was wastewater discharge from the residential complex. The area also appeared active in the 1959 photographs, but the use of the ditches declined with the removal of the residential complex. The housing area was leveled in 1966.

Currently, only concrete foundations remain in the former housing area, and the site is fenced and used as part of the TEAD horse stable complex. Horse grazing occurs on the Wastewater Spreading Area. During the Phase I RI field investigation program conducted by Rust E&I in the summer of 1992 and the Phase II RI program in the summer of 1994, the ditches, ravine, and spreading area were dry; there was no evidence of continued discharging. The ditches contain vegetation and, in many places, are difficult to discern. While sampling the soil to the east of the railroad tracks in July 1994, workers noticed flowing water related to water lines buried in the pasture in three areas. The source of this water is unknown, but it appears as though the water had been leaking for a considerable amount of time because of the different vegetation growing in these wet areas. Standing or running water was present in the area of the stable and pasture on the days when the soil samples were collected. Buried metal debris was found 2 feet below the surface in one test pit, WSP-94-07, located in the ravine just east of the wastewater spreading area (Figure 4-6). This is the only test pit or subsurface soil sample location where buried debris was found at the site. In July 1995, Rust E&I conducted an additional survey of the ravine area using a metal detector and visual observation to better define the extent of metal debris. Debris was found to be restricted to a small area in the location of test pit WSP-94-07 and consisted of automobile parts and remnants of tires on the ground surface. No additional buried debris was indicated by the metal detector. Photographs of the debris are included in Appendix C.

4.3.2 Previous Investigations and Phase I and Phase II RI Activities

At the Wastewater Spreading Area, there were no environmental investigations prior to the Phase I RI conducted by Rust E&I. Surface- and subsurface-soil samples were taken from the ditches, ravine, and spreading areas during Phase I to determine if contaminants were released to site soils as a result of previous wastewater discharge. The sample locations and results for the Phase I field investigation are shown in Figure 4-7. Six surface soil samples were collected a depth of 0 to 6 inches, and nine subsurface soil samples were collected at depths ranging from 2 to 6 feet. These Phase I soil samples were analyzed for VOCs, SVOCs, metals, and anions. The pesticide chlordane was tentatively identified in one of the Phase I surface soil samples, and three of the surface soil samples had lead concentrations above background. As a result, additional soil samples were collected during the Phase II RI field investigation to better delineate the extent of chlordane and lead contamination. Thirteen surface soil samples (0 to 6 inches) and seven subsurface soil samples (3 feet) were collected during Phase II (Figure 4-6). Three of the subsurface samples were collected using a stainless-steel hand auger and four were collected using a backhoe because of the coarse cobble gravel present below the surface. All of the soil samples collected at the Wastewater Spreading Area were analyzed for pesticides to determine the source and extent of the chlordane contamination detected during the Phase I field investigation. To determine the horizontal extent of lead contamination identified during Phase I, four surface soil samples were collected in the spreading areas during the Phase II RI field investigation for metals analysis. In addition to the soil samples collected during Phase II RI field activities, water supply well WW-1 was sampled for SVOCs, VOCs, pesticides, metals, and explosives to determine if any migration of soil contaminants to groundwater may have occurred from the Wastewater Spreading Area (SWMU 35).

4.3.3 Contamination Assessment

4.3.3.1 *Data Evaluation*

This section evaluates the analytical data for its usability in the risk assessment. A data evaluation was performed by reviewing the data quality codes assigned by the USAEC Chemistry Branch and EcoChem, an independent third-party validator. In an effort to ascertain the level of certainty/uncertainty, USEPA data qualification codes were then assigned as an aid in interpreting the data for use in the risk assessment. (Table 2-4 defines the relationship between the USAEC Chemistry Branch codes and USEPA data qualifiers.) The following sections summarize the results of this process.

4.3.3.1.1 ***Field Duplicates.*** The "D" flag code represents a field duplicate. All "D" flagged data were compared with the primary investigative result, and the higher of the two values was used in the quantitative risk assessment.

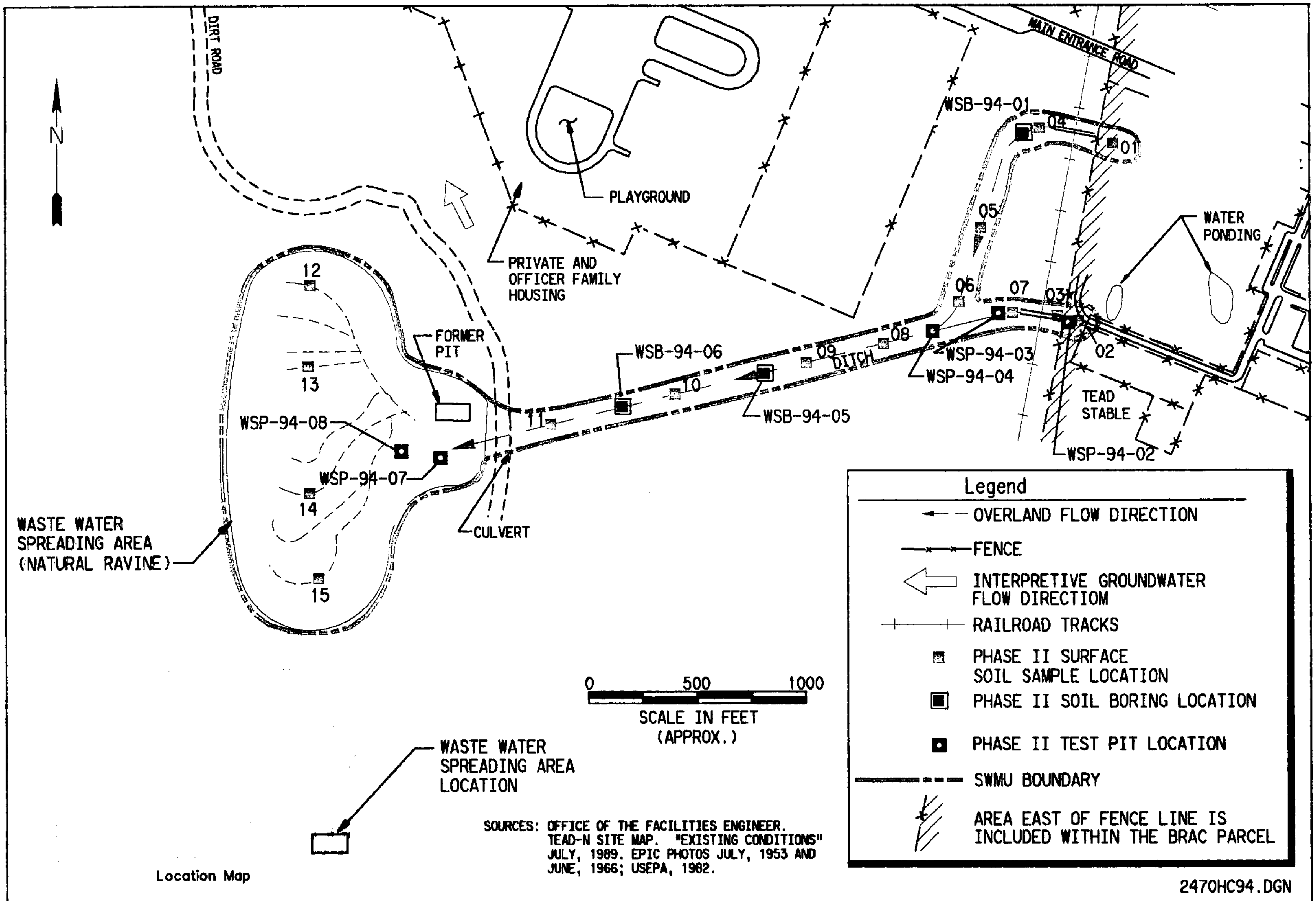


Figure 4-6. SWMU 35 Location Map and Phase II Sample Locations

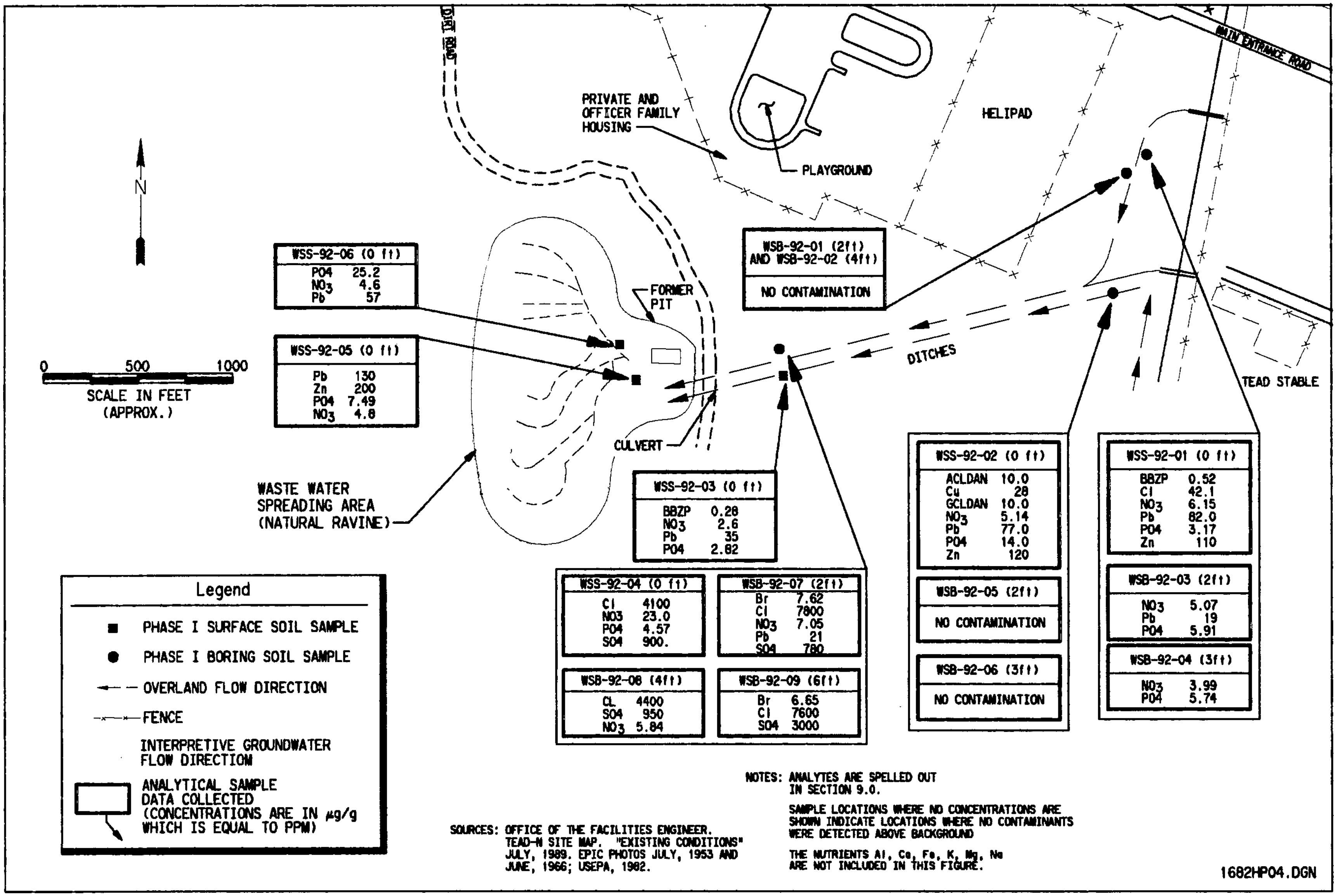


Figure 4-7. Phase I RI Sample Locations and Results

4.3.3.1.2 ***Blank Assessment.*** The USEPA has determined that when blank contamination exists, the investigative results must exceed the blank result by a factor of 5 (all compounds) or 10 (common laboratory contaminants such as acetone) in order to be considered positive. Acetone and methylene chloride were detected in method and/or trip blanks associated with SWMU 35 soil samples. Based on comparisons to blanks, acetone and methylene chloride results were changed to nondetects for the following samples. As specified in USEPA guidance (USEPA 1989), the associated blank concentration was considered the quantitation limit for the affected samples.

- Surface Soil
  -Acetone—WSS-92-01, -02, -03, -04, 05, and -06
  -Methylene chloride—WSS-92-01, -02, -03, -04, -05, and -06

- Subsurface Soil
  -Acetone—WSB-92-01, -02, -05, and -09
  -Methylene chloride—WSB-92-01, -02, -03, -04, -05, -06, -07, -08, and -09

4.3.3.1.3 ***USAEC Chemistry Branch Validation.*** The USAEC Chemistry Branch reviewed the analytical data for technical deficiencies based on the *USATHAMA (USAEC) Quality Assurance Program (PAM 11-41)*. USAEC data qualifiers assigned by the Chemistry Branch would be an indication of QC recoveries outside of USAEC control limits and other technical deficiencies. Estimating the data for use in the risk assessment based on USAEC data qualifiers is judged to be a conservative approach since USAEC control limits are generally narrower than USEPA Functional Guidelines.

For SWMU 35, the USAEC assigned qualifiers to several pesticide analytes in Lot ANHJ, indicating QC recoveries above the control limits. Since EcoChem also reviewed this lot in their data quality assessment, no USEPA data qualifiers were assigned based on USAEC information. Only those recommended by EcoChem were incorporated. A discussion of EcoChem's findings for this lot is provided in the third-party validation section.

Non-Certified Compounds. USAEC flag codes of R or T were assigned by the analytical laboratory to indicate non-detected compounds which had not been performance demonstrated or validated under the USAEC's 1990 QA program. Under this program a distinction is made between "target" and "non-target" analytes. "Target" compounds are determined during the certification process, and CRLs for these analytes are established. "Non-target" compounds are those which were added to the method to meet project-specific requirements. The lowest calibration standard typically reflects the PQL for that analyte. For the purpose of the risk assessment, the detection limit will be assigned a J-code, due to the uncertainty associated with not having undergone a rigorous certification process.

4.3.3.1.4 ***Independent Third-Party Data Validation.*** A data quality assessment was completed using a validation effort by EcoChem, an independent third party. EcoChem's review and recommendations were based on USEPA Functional Guidelines as well as the *USATHAMA (USAEC) Quality Assurance Program (PAM 11-41)* and individual methods. All USEPA data qualifiers recommended by EcoChem were incorporated for use in the risk assessment and are provided in the analytical summary tables of Appendix J.

For SWMU 35, 1994 data, EcoChem evaluated one lot each of pesticide analyses by Method LH17 (soil) and Method UH20 (water) and one lot of explosive analysis by Method UW25 (water).

For the pesticide analyses of soil samples, Lot ANJH, EcoChem rejected seven samples (all non-detects) due to the suspected presence of technical chlordane. EcoChem estimated (J or UJ) all other analytes in the associated samples as a result. EcoChem also reviewed the qualifiers assigned by the USAEC Chemistry Branch and analytical laboratory, which indicated QC spike recoveries above control limits. EcoChem determined the high recoveries were a one time occurrence due to an isolated incident, (cracked vial allowed solvent to escape, concentrating the sample) which had no significant impact on the results. Based on this information, no qualifications were issued.

For the pesticide water analyses, Lot ANWT, EcoChem estimated detection limits (UJ) for endosulfan I.

For the explosive analyses, Lot ANRS, EcoChem qualified all RDX data (all non-detects) as estimated (UJ) due to poor spike recoveries.

For SWMU 35, 1992 data, EcoChem evaluated two lots of semivolatile organic analyses of soil samples using Method LM15 and one lot of GFAA lead analyses of soil samples using Method JD13.

For the semivolatile analyses, Lots SJT and SJU, EcoChem rejected the CRL for endosulfan I (Lot SJT) and parathion (Lot SJU) because of instrument-sensitivity problems. Several more results were estimated (coded J or UJ) because of calibration outliers or low internal standard areas. (Affected analytes and sample IDs are listed on the transfer files in Appendix J.)

All other data were judged acceptable for use without qualification. Listed below are the sample results rejected for use in the risk assessment:

- Surface Samples
  -Chlordane—WSS-94-03, -06, -07, -08, -09, and dup
  -Endosulfan I—WSS-92-01,
  -Parathion—WSS-92-02, -03, -04, -05, -06

- Subsurface Samples
  -Endosulfan I—WSB-92-01, -02

4.3.3.1.5 ***Data Evaluation Summary.*** A total of 19 surface soil samples (and 1 duplicate) and 16 subsurface soil samples were collected in 1992 and 1994 from 4 test pits, 12 borings, and 19 surface locations at SWMU 35. Subsurface samples were collected at depths of 1.5 to 6 feet. Samples were analyzed for one or more of the following groups of chemicals: volatiles, semivolatiles, anions, metals, explosives, and pesticides/PCBs. Water supply well WW-1 was also sampled and analyzed for explosives, metals, pesticides/PCBS, semivolatiles, and volatiles.

Arsenic reporting limits for the 1992 samples ranged from 24 to 240 $\mu g/g$, above the background screening value of 11.7 $\mu g/g$. Arsenic detections in the four 1994 samples from the Wastewater Spreading Area were elevated above background and ranged from 15.6 to 32 $\mu g/g$. The 1994 samples from the stable area were not analyzed for arsenic. Since the majority of pesticides were detected in the stable area, and since arsenicals have been used as pesticides, the magnitude and extent of arsenic contamination may not be adequately characterized in this area. Both zinc and lead were also detected above background in the stable area.

Antimony and thallium were not detected in any samples at this SWMU. Thallium reporting limits ranged from 34.3 to 1,700 $\mu g/g$ (one sample only), which exceed the background screening value (11.7 $\mu g/g$). Thallium salts have historically been used as pesticides and may be present in trace amounts. However, the current land use PRGs calculated by Dames and Moore (1996) for thallium (98.1 to 1330 $\mu g/g$) are higher than all but one of the non-detects. Therefore, data gaps don't exist for thallium under current land use conditions. The reporting limit for antimony of 19.6 $\mu g/g$ exceeds the background screening value of 15 $\mu g/g$. As with thallium, however, the PRGs (136 to 467 $\mu g/g$) are higher than the non-detects indicating no data gap exists under current land use conditions. Any future residential land use may necessitate additional soil sampling for antimony and thallium.

Four alpha endosulfan nondetect results, five parathion nondetect results, and seven technical chlordane nondetect results were rejected. Additionally, the results for many pesticides were considered to be potentially over-estimated in several 1994 samples due to the potential masking effect of technical chlordane. Semivolatile results for several 1992 samples were potentially underestimated due to low internal standard areas.

Approximately 98 percent of sample results were judged to be usable for risk assessment purposes. In general, the number of samples and the analytical parameter list appear to be sufficient to characterize the nature, extent, and potential magnitude of contamination at this SWMU with the exception noted above. Results of the single round of groundwater sampling at WW-1 will be supplemented with vadose zone modeling of COPCs in soil. A summary of chemicals detected in at least one surface or subsurface sample at SMWU 35 is presented in Appendix J, including corresponding data qualifiers (as appropriate) based on USEPA functional guidelines.

4.3.3.1.6 ***Background Screening.*** The maximum concentrations of inorganic chemicals detected in soil at SWMU 35 were compared to the SWMU-specific background screening values (see Section 2.6). Any inorganic chemical detected in at least one sample at a concentration higher than the background screening value was retained in the COPC database. Surface soil and subsurface soil were screened separately. The results of the background

screening are shown in Table 4-34. Based on this screening analysis, arsenic, cadmium, cobalt, copper, lead, magnesium, potassium, and zinc are the inorganic analytes that can be considered potential contaminants in surface soils at SWMU 35. Iron and lead exceeded background threshold values in subsurface soil at this SWMU. Although arsenic was not detected in subsurface soil, the reporting limit for all samples exceeded the background screening level of 11.7 μg/g.

4.3.3.2 *Summary of Analytical Results*

The list of analytes detected in at least one surface or subsurface soil sample is provided in Table 4-35 for Phase I data and in Table 4-36 for Phase II data.

4.3.3.3 *Nature and Extent of Contamination*

In the Phase I RI investigation, SVOCs were detected in two surface soil samples only. Butyl benzyl phthalate was detected at a concentration of 0.28 μg/g in WSS-92-03 and 0.52 μg/g in WSS-92-01. The only pesticides alpha-chlordane and gamma-chlordane were each tentatively identified at a concentration of 10 μg/g in sample WSS-92-02. Lead was detected above background in surface soil sample locations WSS-92-01, -02, -03, -05, and -06, and also was detected above background in subsurface samples WSB-92-03 and -07. Anions were detected in surface or subsurface soils at locations WSS-92-01, -02, -04, -05, -06, and WSB-92-03, -04, -07, -08, and -09. Sample location WSS-92-05 in the Wastewater Spreading Area had the highest detection of inorganics, including lead (130 μg/g) and zinc (200 μg/g). Subsurface samples WSB-92-03 and WSB-92-04 had detects of phosphate and nitrate. WSB-92-07, -08, and -09 also had detects of anions, including sulfate, chloride, bromide, nitrate, and phosphate (see Figure 4-7). WSB-92-03 and WSB-92-07 also had detects of lead at 19.0 μg/g and 21.0 μg/g, respectively. Based on these sampling results, additional sampling of the area was necessary to further define the areal and vertical extent of pesticide and metals contamination.

A Phase II RI investigation of the Wastewater Spreading Area was completed in July of 1994. Pesticides and metals were found in surface and subsurface soils during the Phase II investigation. Figure 4-8 shows the distribution of pesticides and metals in surface soil, and Figure 4-9 shows the subsurface distribution. Of the pesticides detected, alpha- and gamma-chlordane, DDT, DDE, DDD, endrin, and heptachlor epoxide (HPCLE) were found to be the most prevalent. Pesticide contamination in surface soil was found to be concentrated in the ditches just west of the TEAD stable area, but was also detected in the ditches as far west as surface sample WSS-94-10 (Figure 4-8). DDE and DDT were also detected in the surface soil samples WSS-94-12 and WSS-94-14 located within the spreading area. In the drainages, pesticides were detected in subsurface soil as far west as boring location WSB-94-05 at 2.0 feet. Pesticides were not detected in boring WSB-94-06, nor test pits WSP-94-07 and WSP-94-08. Elevated metals, including arsenic, cadmium, cobalt, lead, magnesium, potassium, and zinc, were found in the surface soils taken from within the spreading area (Figure 4-8). WSS-94-12 and WSS-94-14 contained elevated lead and zinc values, and

Table 4-34. Background Screening of Inorganic Chemicals Detected in Soil at SWMU 35

Chemical	Frequency of Detection[a]	Maximum Detected Value (µg/g)	SWMU-specific Background Screening Value[b] (µg/g)	Exceeds SWMU-specific Background?
Surface Soil				
Aluminum	4/4	19,500	28,083	No
Arsenic	4/10	32	11.69	**YES**
Barium	10/10	195	247	No
Beryllium	4/10	0.918	1.46	No
Cadmium	2/10	1.43	0.847	**YES**
Calcium	4/4	43,300	114,483	No
Chromium	10/10	20.6	20.62	No
Cobalt	4/4	7.8	6.94	**YES**
Copper	10/10	28.0	24.72	**YES**
Iron	10/10	22,000	22,731	No
Lead	10/10	130	18.23	**YES**
Magnesium	4/4	11,700	7,062	**YES**
Manganese	4/4	663	698	No
Mercury	1/10	0.0358	0.0572	No
Nickel	4/10	15.1	17.40	No
Potassium	4/4	7,030	5,450	**YES**
Silver	6/10	0.479	0.66	No
Sodium	4/4	269	337	No
Vanadium	4/4	20.4	28.39	No
Zinc	10/10	200	102.8	**YES**
Subsurface Soil				
Barium	9/9	230	247	No
Chromium	9/9	18.6	18.6	No
Copper	9/9	15.0	24.72	No
Iron	9/9	27,000	22,731	**YES**
Lead	9/9	21.0	18.23	**YES**
Silver	7/9	0.17	0.66	No
Zinc	9/9	78.0	102.8	No

[a]Number of samples in which the analyte was detected/total number of samples analyzed.

[b]See Section 2.6.1.1 for an explanation of how the SWMU-specific background screening values were calculated.

Table 4-35. Summary of Analytes Detected in Soil for the Wastewater Spreading Area (SWMU 35) - Phase I

Surface Soil

Group	Analytes	Background Concentrations	WSS-02-01 (0ft)	WSS-02-02 (0ft)	WSS-02-03 (0ft)	WSS-02-04 (0ft)	WSS-02-05 (0ft)	WSS-02-06 (0ft)
METALS	BARIUM	247.1	160	120	98	170	120	120
	CHROMIUM	20.62	18.4	18.1	14.7	20.8	16.2	16.7
	COPPER	24.72	21	28*	12.6	8.98	22.6	15.6
	IRON	22731	19000	17000	13000	22000	14000	18000
	LEAD	18.23	82*	77*	35*	17	130*	57*
	MERCURY	0.0672	LT 0.0259	LT 0.0259	LT 0.0259	LT 0.0259	0.0358	LT 0.0259
	SILVER	0.86	0.262	0.366	0.24	0.346	0.479	0.234
	ZINC	102.8	110*	120*	63	82	200*	95
SEMIVOLATILES	BUTYLBENZY	N/A	0.52*	ND 0.33	0.28*	ND 0.33	ND 0.33	ND 0.33
	ALPHA CHLO	N/A	ND 1	10*	ND 1	ND 1	ND 1	ND 1
	GAMMA-CHL	N/A	NT	10*	NT	NT	NT	NT
ANIONS	CHLORIDE	N/A	42.1*	LT 39.6	LT 39.6	4100*	LT 39.6	LT 39.6
	NITRATE	N/A	6.15*	5.14*	2.6*	23*	4.8*	4.6*
	PHOSPHATE	N/A	3.17*	14*	2.82*	4.57*	7.49*	25.2*
	SULFATE	N/A	14.4#	12.7#	LT 14.4	900*	LT 14.4	LT 14.4

Subsurface Soil

Group	Analytes	Background Concentrations	WSB-02-01 (2ft)	WSB-02-02 (4ft)	WSB-02-03 (2ft)	WSB-02-04 (3ft)	WSB-02-05 (2ft)	WSB-02-06 (3ft)	WSB-02-07 (2ft)	WSB-02-08 (4ft)	WSB-02-09 (6ft)
METALS	BARIUM	247.1	170	130	73	63	40	31	230	93	80
	CHROMIUM	20.62	18.6	14.2	13.3	9.32	7.94	8.82	17.3	18	11
	COPPER	24.72	9.68	6.08	9.11	4.68	4.5	3.26	16	10.7	6.5
	IRON	22731	20000	13000	10000	7300	6800	6000	27000*	17000	12000
	LEAD	18.23	15	9.5	19*	9.9	8.1	7.5	21*	14	14
	SILVER	0.86	0.0697	0.0358	0.164	0.17	0.0288	0.0286	0.0368	LT 0.0148	LT 0.0148
	ZINC	102.8	46	38	46	17.9	16.9	11.8	78	49	27
ANIONS	BROMIDE	N/A	NT	NT	LT 8.83	LT 8.83	LT 8.83	LT 8.83	7.62*	LT 8.83	6.65*
	CHLORIDE	N/A	NT	NT	LT 39.6	LT 39.6	LT 39.6	LT 39.6	7800*	4400*	7600*
	NITRATE	N/A	NT	NT	5.07*	3.99*	LT 3.38	LT 3.38	7.65*	5.84*	LT 3.38
	PHOSPHATE	N/A	NT	NT	5.91*	5.74*	ND 6	ND 6	ND 6	ND 6	ND 6
	SULFATE	N/A	NT	NT	LT 14.4	LT 14.4	LT 14.4	LT 14.4	780*	950*	3000*

Note.- All values in $\mu g/g$ (equal to ppm).

N/A = Not Applicable.

* = Organic analyte detected above CRL or MDL or detected inorganic analyte exceeding background.

LT = Analyte concentration is less than CRL, the CRL is posted next to the "LT".

ND = Analyte not detected above the MDL, the MDL is posted next to the "ND";

NT = Not Tested.

= Analyte was detected in the associated blank in excess of the 5 or 10 times rule (as described in Section 3.1.1.1).

Table 4-36. Summary of Analytes Detected in Soil for the Wastewater Spreading Area (SWMU 35) - Phase II

			Surface Soil										
Group	Analytes	Background Concentrations	WSS-94-03 (0.5ft)	WSS-94-04 (0.5ft)	WSS-94-05 (0.5ft)	WSS-94-06 (0.5ft)	WSS-94-07 (0.5ft)	WSS-94-08 (0.5ft)	WSS-94-09 (0.5ft)	WSS-94-09(D) (0.5ft)	WSS-94-10 (0.5ft)	WSS-94-11 (0.5ft)	WSS-94-12 (0.5ft)
METALS	ALUMINUM	28083	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	19200
	ARSENIC	11.69	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	32*
	BARIUM	247.1	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	179
	BERYLLIUM	1.466	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.736
	CADMIUM	0.847	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	1.32*
	CALCIUM	114483	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	15700
	CHROMIUM	20.62	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	18.9
	COBALT	6.94	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	7.27*
	COPPER	24.72	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	23.3
	IRON	22731	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	20000
	LEAD	18.23	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	69*
	MAGNESIUM	7061	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	10800*
	MANGANESE	698.3	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	883
	NICKEL	17.4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	13.9
	POTASSIUM	5449	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	6850*
	SODIUM	337	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	252
	VANADIUM	28.39	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	19.5
	ZINC	102.8	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	139*
PESTICIDES/PCBS	ALDRIN	N/A	0.018*	LT 0.0014	LT 0.0014	LT 0.0014	LT 0.0014	LT 0.0014	LT 0.0014	LT 0.0014	LT 0.0014	LT 0.0014	LT 0.0014
	ALPHA-ENDOSULFAN	N/A	0.0118*	LT 0.001	LT 0.001	0.00247*	0.38*	0.006*	LT 0.001	LT 0.001	LT 0.001	LT 0.001	LT 0.001
	BETA-BENZENEHEXACHLORIDE	N/A	LT 0.0077	LT 0.0077	LT 0.0077	LT 0.0077	0.16*	LT 0.0077	LT 0.0077	LT 0.0077	LT 0.0077	LT 0.0077	LT 0.0077
	BETA-ENDOSULFAN	N/A	0.018*	LT 0.0007	LT 0.0007	LT 0.0007	LT 0.0007	LT 0.0007	LT 0.0007	LT 0.0007	LT 0.0007	LT 0.0007	LT 0.0007
	DDD	N/A	0.0118*	0.00477*	0.00687*	0.0143*	0.11*	LT 0.0027	LT 0.0027	LT 0.0027	LT 0.0027	LT 0.0027	LT 0.0027
	DDE	N/A	0.036*	0.0284*	0.0618*	1.3*	0.68*	0.0202*	0.00567*	0.00709*	0.019*	LT 0.0027	0.0149*
	DDT	N/A	0.00976*	0.0152*	0.0365*	0.0752*	0.0255*	0.00659*	0.00562*	0.00703*	0.00761*	LT 0.0035	0.0161*
	DELTA-BENZENEHEXACHLORIDE	N/A	0.0394*	LT 0.0086	LT 0.0086	LT 0.0086	2.4*	LT 0.0086	LT 0.0086	LT 0.0086	LT 0.0086	LT 0.0086	LT 0.0086
	DIELDRIN	N/A	0.00282*	LT 0.0018	LT 0.0018	LT 0.0018	0.0335*	0.00717*	LT 0.0018	LT 0.0018	LT 0.0018	LT 0.0018	LT 0.0018
	ENDOSULFAN SULFATE	N/A	0.016*	ND 0.0005	ND 0.0005	ND 0.0005	0.037*	ND 0.0005	ND 0.0005	ND 0.0005	ND 0.0005	ND 0.0005	ND 0.0005
	ENDRIN	N/A	0.16*	LT 0.0065	LT 0.0065	0.019*	4*	0.0424*	LT 0.0065	LT 0.0065	LT 0.0065	LT 0.0065	LT 0.0065
	ENDRIN ALDEHYDE	N/A	0.0065*	ND 0.0005	ND 0.0005	ND 0.0005	0.016*	ND 0.0005	ND 0.0005	ND 0.0006	ND 0.0006	ND 0.0005	ND 0.0005
	ENDRIN KETONE	N/A	0.000593*	ND 0.0005	ND 0.0005	ND 0.0005	0.0093*	ND 0.0005	ND 0.0006	ND 0.0005	ND 0.0005	ND 0.0005	ND 0.0005
	HEPTACHLOR	N/A	LT 0.0022	LT 0.0022	LT 0.0022	LT 0.0022	0.15*	LT 0.0022	LT 0.0022	LT 0.0022	LT 0.0022	LT 0.0022	LT 0.0022
	HEPTACHLOREPOXIDE	N/A	0.0141*	LT 0.0013	LT 0.0013	0.00954*	0.25*	0.00656*	LT 0.0013	0.00181*	LT 0.0013	LT 0.0013	LT 0.0013
	LINDANE	N/A	0.014*	LT 0.001	LT 0.001	LT 0.001	0.0408*	LT 0.001	LT 0.001	LT 0.001	LT 0.001	LT 0.001	LT 0.001
	ALPHA CHLORDANE	N/A	0.243*	ND 0.004	ND 0.004	0.0512*	0.187*	0.105*	0.00776*	0.00935*	ND 0.004	ND 0.004	ND 0.004
	GAMMA-CHLORDANE	N/A	0.283*	ND 0.004	ND 0.004	0.0365*	0.158*	0.0775*	0.00569*	0.00686*	ND 0.004	ND 0.004	ND 0.004

Table 4-36. *Summary of Analytes Detected in Soil for the Wastewater Spreading Area (SWMU 35) - Phase II (continued)*

Surface Soil

Group	Analytes	Background Concentrations	WSS-94-13 (0.5ft)	WSS-94-14 (0.5ft)	WSS-94-15 (0.5ft)
METALS	ALUMINUM	28083	14000	16100	19500
	ARSENIC	11.69	16.3*	19.1*	15.6*
	BARIUM	247.1	163	182	196
	BERYLLIUM	1.466	0.621	0.653	0.918
	CADMIUM	0.847	LT 1.2	1.43*	LT 1.2
	CALCIUM	114483	39000	23200	43300
	CHROMIUM	20.62	14.4	16	19.8
	COBALT	6.94	5.78	6.11	7.8*
	COPPER	24.72	17.7	22.6	20.6
	IRON	22731	16800	17000	20900
	LEAD	18.23	39.6*	59.5*	49.6*
	MAGNESIUM	7081	9850*	9480*	11700*
	MANGANESE	698.3	476	679	664
	NICKEL	17.4	11.8	13.1	16.1
	POTASSIUM	5449	4980	5760*	7030*
	SODIUM	337	221	244	269
	VANADIUM	28.39	17.3	18.2	20.4
	ZINC	102.8	76.2	125*	101
PESTICIDES/PCBS	ALDRIN	N/A	LT 0.0014	LT 0.0014	LT 0.0014
	ALPHA-ENDOSULFAN	N/A	LT 0.001	LT 0.001	LT 0.001
	BETA-BENZENEHEXACHLORIDE	N/A	LT 0.0077	LT 0.0077	LT 0.0077
	BETA-ENDOSULFAN	N/A	LT 0.0007	LT 0.0007	LT 0.0007
	DDD	N/A	LT 0.0027	LT 0.0027	LT 0.0027
	DDE	N/A	LT 0.0027	0.00898*	LT 0.0027
	DDT	N/A	LT 0.0036	0.0111*	LT 0.0036
	DELTA-BENZENEHEXACHLORIDE	N/A	LT 0.0086	LT 0.0086	LT 0.0086
	DIELDRIN	N/A	LT 0.0016	LT 0.0016	LT 0.0016
	ENDOSULFAN SULFATE	N/A	ND 0.0006	ND 0.0006	ND 0.0006
	ENDRIN	N/A	LT 0.0066	LT 0.0066	LT 0.0066
	ENDRIN ALDEHYDE	N/A	ND 0.0006	ND 0.0006	ND 0.0006
	ENDRIN KETONE	N/A	ND 0.0006	ND 0.0006	ND 0.0006
	HEPTACHLOR	N/A	LT 0.0022	LT 0.0022	LT 0.0022
	HEPTACHLOREPOXIDE	N/A	LT 0.0013	LT 0.0013	LT 0.0013
	LINDANE	N/A	LT 0.001	LT 0.001	LT 0.001
	ALPHA CHLORDANE	N/A	ND 0.004	ND 0.004	ND 0.004
	GAMMA-CHLORDANE	N/A	ND 0.004	ND 0.004	ND 0.004

Subsurface Soil

Group	Analytes	Background Concentrations	WSB-94-01 (1.5ft)	WSP-94-03 (3ft)	WSP-94-04 (3ft)	WSB-94-05 (2ft)	WSB-94-06 (3ft)	WSP-94-07 (3ft)	WSP-94-08 (3ft)
PESTICIDES/PCBS	ALDRIN	N/A	LT 0.0014	0.00194*	LT 0.0014	LT 0.0014	LT 0.0014	LT 0.0014	LT 0.0014
	DDE	N/A	0.00341*	LT 0.0027	0.0045*	0.00972*	LT 0.0027	LT 0.0027	LT 0.0027
	DDT	N/A	0.00681*	LT 0.0035	LT 0.0035	[illegible]*	LT 0.0035	LT 0.0035	LT 0.0035
	DELTA-BENZENEHEXACHLORIDE	N/A	LT 0.0085	0.0103*	LT 0.0085	LT 0.0085	LT 0.0085	LT 0.0085	LT 0.0085
	ALPHA CHLORDANE	N/A	ND 0.004	0.0598*	0.0598*	ND 0.004	ND 0.004	ND 0.004	ND 0.004
	GAMMA-CHLORDANE	N/A	ND 0.004	0.0666*	0.0601*	ND 0.004	ND 0.004	ND 0.004	ND 0.004

Note.- All values in µg/g (equal to ppm).
N/A = Not Applicable.
NT = Not Tested.
LT = Analyte concentration is less than CRL , the CRL is posted next to the "LT".
* = Organic analyte detected above CRL or MDL or detected inorganic analyte exceeding background.
ND = Analyte not detected above the MDL, the MDL is posted next to the "ND".
(D) = Duplicate analysis.

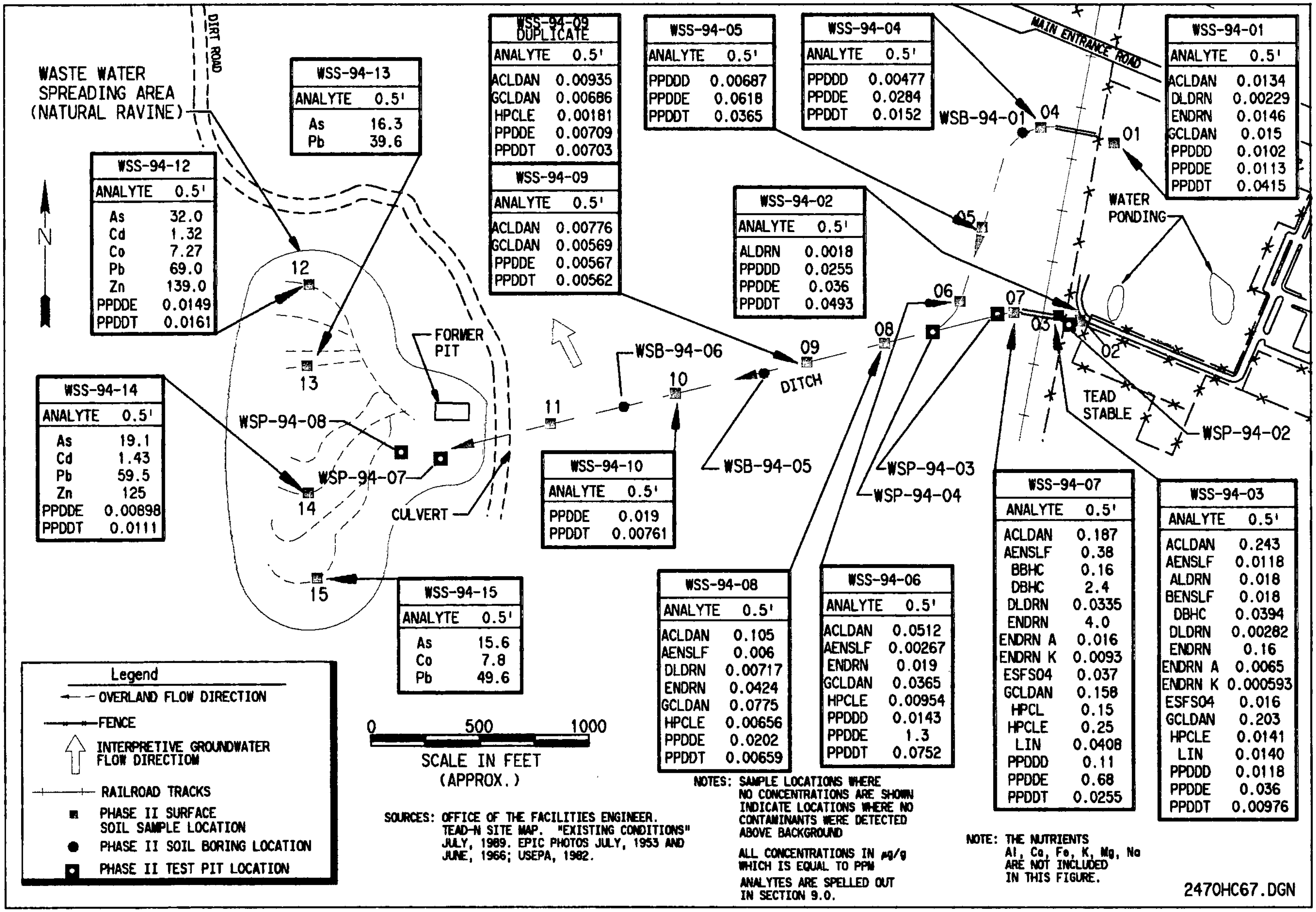


Figure 4-8. SWMU 35 Phase II Distribution of Pesticides and Metals in Surface Soil

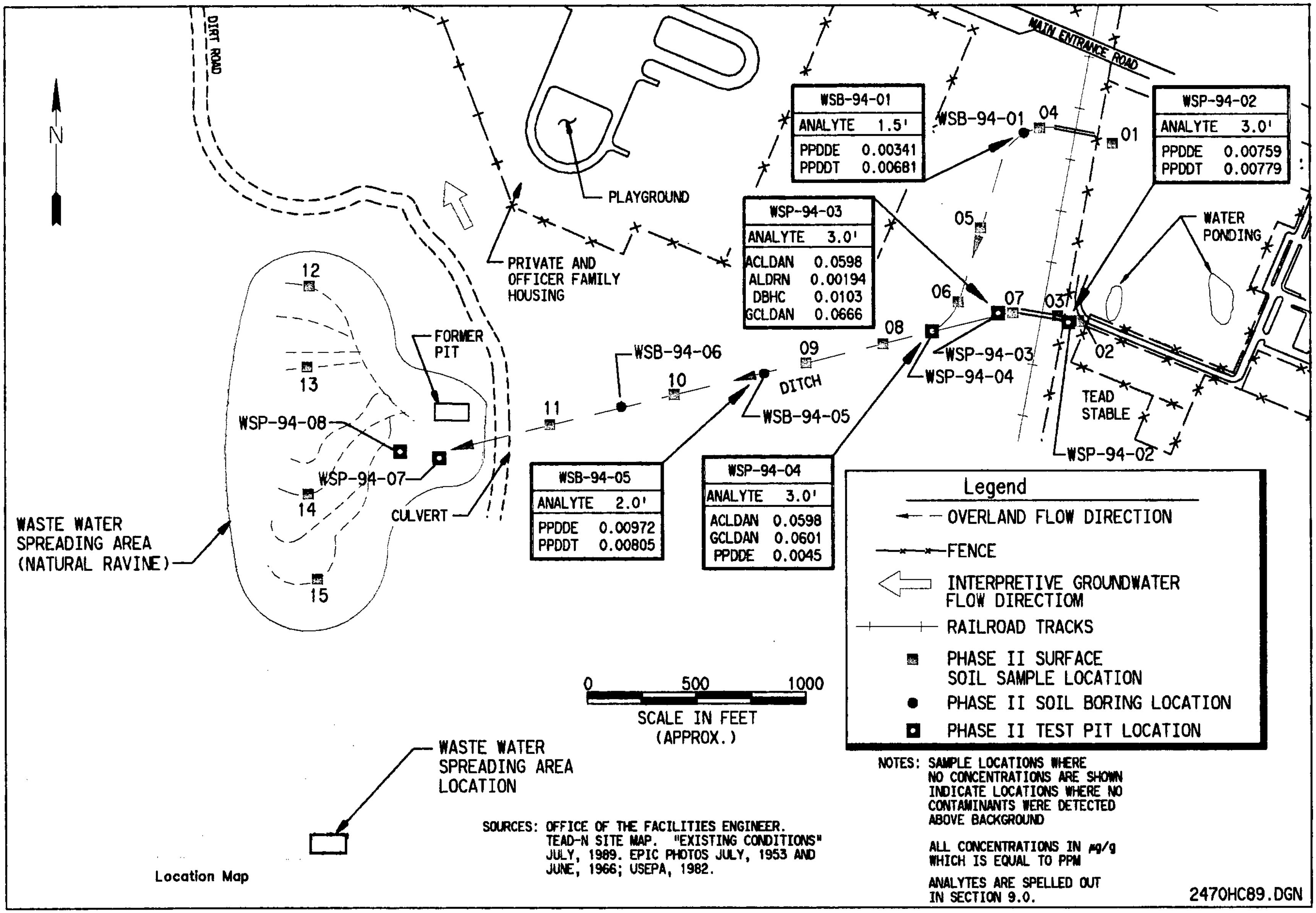


Figure 4-9. SWMU 35 Phase II Subsurface Soil Sample Results

WSS-94-13 and -15 contained elevated levels of lead, confirming results from the Phase I locations WSS-92-05 and WSS-92-06 immediately upgradient. Possible sources of the elevated metals could be scrap metal and miscellaneous automotive debris discarded in the discharge end of the drainage. As previously described, the Phase II location WSP-94-07, located within the discharge end of the drainage upgradient of the spreading area, contained miscellaneous metal debris.

WW-1, chosen as a downgradient control point, is located approximately 4,400 feet downgradient of the Wastewater Spreading Area, and was sampled and analyzed for explosives, metals, pesticides, SVOCs, and VOCs. This well is one of five authorized water supply wells for TEAD-N and was sampled because it is located in the vicinity of SWMU 35. Monitoring well N-142-93 is also located downgradient of SWMU 35. Samples collected from approximately the same screened interval (392 to 423 feet in WW-1 and 355 to 375 feet in N-142-93) show that there are no COPCs in either well. Indeed, Montgomery Watson (1994) stated that both of these wells are believed to be a reliable measure of upgradient conditions for SWMU 45. Therefore, it can also be stated that either well represents downgradient conditions for SWMU 35. Analytical results for WW-1 indicate all parameters analyzed were less than the CRL or below detection limits with the exception of barium, calcium, potassium, magnesium, sodium, and 1,1,1-trichloroethane (Table 4-37). Of these six constituents, only barium and trichloroethane have been assigned MCLs based on the primary and secondary drinking water standards. Barium, which was detected at a concentration of 43.1 μg/L for the filtered sample and 45.6 μg/L for the unfiltered sample, does not exceed the MCL standard of 2,000 μg/L. The compound 1,1,1-trichloroethane was detected at a concentration of 1.4 μg/L which does not exceed the MCL standard of 200 μg/L. In addition, 1,1,1-trichloroethane was detected at 3.9 μg/L in the method blank for the analytical lot for this sample, indicating the detection is likely the result of laboratory contamination.

Table 4-37. Detected Analytes in Groundwater Collected from WW-1

Analyte	Unfiltered Sample	Unfiltered Duplicate	Filtered Sample	Filtered Duplicate	MCL[a]
Barium	45.6[b]	44.2	43.1	44.5	2,000
Calcium	178,000	177,000	173,000	176,000	NA[c]
Potassium	5,460	5,620	5,280	5,310	NA
Magnesium	77,300	76,900	75,700	76,800	NA
Sodium	120,000	119,000	117,000	118,000	NA
1,1,1-trichloroethane	1.4[d]	NA	NA	NA	200

[a]Maximum contaminant level.
[b]All units in μg/L.
[c]Not applicable.
[d]1,1,1-trichloroethane detected at 3.9 μg/L in the method blank.

4.3.4 Human Health Risk Assessment

As part of the Phase II RI, an RA was conducted to estimate potential human health risks associated with the no-action alternative for SWMU 35. The following tasks were completed in the RA:

- Data analysis and selection of COPCs
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Sumary and conclusions

This section provides a summary of the quantitative process employed at SWMU 35 and the results of that process. The RA for SWMU 35 is based on the methodology described in Section 3.1 and supported by Appendices L, M, N, and O.

4.3.4.1 *Selection of the Chemicals of Potential Concern - Soils*

As detailed in USEPA Region VIII guidance, a screening procedure can be used to narrow the list of contaminants at a particular site to a subset of analytes that can be considered the COPCs for the area. This screening procedure can involve up to four steps, depending on the contaminants present:

- Group data by chemical class (e.g., carcinogenic PAHs)
- Evaluate frequency of detection
- Evaluate essential nutrients
- Compare site data to risk-based screening concentrations (Region III values)

Below is the screening analysis for SWMU 35.

4.3.4.1.1 ***Data Grouping.*** No data grouping was necessary as part of COPC selection at SWMU 35.

4.3.4.1.2 ***Frequency of Detection.*** No evaluation of detection frequency was undertaken at this site due to insufficient sample size.

4.3.4.1.3 ***Nutrient Screening.*** The nutrient metals magnesium and potassium were detected in surface soil above background threshold values. The maximum concentration of each of these metals was less than the nutrient screening value: magnesium (maximum value 11,700 μg/g, screening value 1,000,000 μg/g) and potassium (maximum value 7,030 μg/g, screening value 150,000 μg/g). Therefore, these two metals were eliminated as COPCs in surface soil.

Iron was the only nutrient metal detected above background in subsurface soil. Since the maximum concentrations of iron, 27,000 $\mu g/g$, was less than the nutrient screening level of 70,000 $\mu g/g$, iron was eliminated as a COPC in subsurface soil.

4.3.4.1.4 ***Region III RBC Screening.*** The final step in the COPC selection process consisted of comparing the EPCs for remaining contaminants in surface and subsurface soil with Region III RBCs. However, before these comparisons can be made, a "hot spot" analysis was conducted.

For the final selection of COPCs, the SWMU was evaluated for possible "hot spots." Pesticides were detected more frequently and in higher concentrations in the ditches west of the stable area than in other sample locations. Therefore, the ditches west of the stable area was evaluated separately as an area of concern. The five samples included in the evaluation of the stable area were WSS-92-02 and WSS-94-03, -06, -07, and -08. All other sample locations were combined to evaluate the remainder of the site. Table 4-38 provides a summary of the exposure point concentrations for preliminary COPCs in surface soil at the ditches west of the stable area and in surface and subsurface soil at the remainder of SWMU 35.

To select COPCs for the soil-related exposure pathways, the EPCs for the site in surface and subsurface soil were compared to Region III soil ingestion and soil-to-air RBCs. As shown in Table 4-39, delta-benzenehexachloride, alpha-chlordane, gamma-chlordane, alpha-endosulfan, endrin, heptachlor, and heptachlor epoxide were retained as COPCs in surface soil in the ditches west of the stable area. Arsenic was the only chemical retained as a COPC in surface soil for the remainder of the site. No chemicals were retained as COPCs in subsurface soil at SWMU 35.

4.3.4.1.5 ***Site-Wide Soils.*** Concentrations of COPCs for surface soils—delta-benzenehexachloride, alpha-chlordane, gamma-chlordane, alpha-endosulfan, endrin, heptachlor, heptachlor epoxide, and arsenic—were calculated on a site-wide basis for the purpose of evaluating SWMU-wide exposure scenarios. Site-wide concentrations were calculated utilizing all surface soil samples collected at SWMU 35. The SWMU-wide concentrations of these surface soil COPCs are provided in Table 4-40.

4.3.4.2 *Selection of Chemicals of Potential Concern-Air*

For all receptors with the exception of the construction worker, the air pathway (i.e., inhalation of particulates) is evaluated on a SWMU-wide basis rather than by area of concern. Because all COPCs in soils were either metals or semi-volatile organics with very low volatility, potential exposures to wind-blown particulate would be contributed to by the entire SWMU (as well as exposed soil outside the defined SWMU), regardless of the specific SWMU-related activity. This was also assumed for potential off-site receptors. Air emissions of SWMU-related chemicals were assumed to occur by entrainment from wind erosion of

Table 4-38. Summary of Preliminary Chemicals of Potential Concern (SWMU 35)

Chemical	Frequency of Detection[a]	Range of Detected Values (μg/g)	Range of Reporting Limits (μg/g)	Arithmetic Mean Concentration (μg/g)	95% UCL Concentration (μg/g)	Exposure Point Concentration[b] (μg/g)
Ditches West of the Stable Area - Surface Soil						
Lead	1/1	77.0	NA[c]	NA	NA	77.0
Copper	1/1	28.0	NA	NA	NA	28.0
Zinc	1/1	120	NA	NA	NA	120
Aldrin	1/5	0.018	0.001 - 0.29	0.025	1.41E+05	0.018
beta-Benzenehexachloride	1/5	0.160	0.0077	0.071	3,852	0.160
delta-Benzenehexachloride	2/5	0.039 - 2.40	0.01 - 0.29	0.391	3.09E+07	2.40
alpha-Chlordane	5/5	0.051 - 10.0	NA	1.18	5.55E+04	10.0
gamma-Chlordane	5/5	0.037 -10.0	NA	1.12	1.78E+05	10.0
p,p′-DDD	3/5	0.012 - 0.110	0.003 - 0.18	0.055	176	0.110
p,p′-DDE	4/5	0.020 - 1.30	0.22	0.448	2,302	1.30
p,p′-DDT	4/5	0.007 - 0.075	0.41	0.063	13.3	0.075
Dieldrin	3/5	0.003 - 0.034	0.001 - 0.30	0.038	1,838	0.034
alpha-Endosulfan	4/5	0.003 - 0.380	1.00	0.200	9.03E+05	0.380
beta-Endosulfan	1/5	0.018	0.001 - 0.20	0.021	2.13E+06	0.018
Endosulfan sulfate	2/5	0.016 - 0.037	0.005 - 0.20	0.053	6.29E+07	0.037
Endrin	4/5	0.019 - 4.00	0.41	0.627	2.88E+04	4.00
Endrin aldehyde	2/4	0.007 - 0.016	0.001	0.006	1.04E+06	0.016
Endrin ketone	2/5	0.001 - 0.009	0.005 - 0.20	0.016	1.05E+06	0.009
Heptachlor	1/5	0.150	0.012 - 0.28	0.064	5.62E+06	0.150
Heptachlor epoxide	4/5	0.007 - 0.250	0.36	0.091	177	0.250
Lindane (gamma-BHC)	2/5	0.014 - 0.041	0.001 - 0.43	0.068	7.31E+-6	0.041
Remainder of Site - Surface Soil						
Arsenic	4/5[d]	15.6 - 32.0	24.0	19.0	31.1	31.1
Cadmium	2/9	1.32 - 1.43	0.424 - 1.20	0.543	1.36	1.36
Cobalt	4/4	5.78 - 7.80	NA	6.74	8.26	7.80
Lead	9/9	17.0 - 130.0	NA	60.2	101	101
Nitrate	5/5	2.60 -23.0	NA	7.80	51.6	23.0
Zinc	9/9	53.0 - 200	NA	107	150	150
Butyl benzyl phthalate	2/9	0.280 - 0.520	0.30 - 0.33	0.211	0.297	0.297

Table 4-38. Summary of Preliminary Chemicals of Potential Concern (SWMU 35) (continued)

Chemical	Frequency of Detection[a]	Range of Detected Values (µg/g)	Range of Reporting Limits (µg/g)	Arithmetic Mean Concentration (µg/g)	95% UCL Concentration (µg/g)	Exposure Point Concentration[b] (µg/g)
alpha-Chlordane	1/9[d]	0.009	0.004	0.003	0.004	0.004
gamma-Chlordane	1/9[d]	0.006	0.004	0.002	0.003	0.003
p,p'-DDD	2/9[d]	0.005 - 0.007	0.0027	0.002	0.004	0.004
p,p'-DDE	6/9[d]	0.007 - 0.062	0.0027	0.018	0.20	0.062
p,p'-DDT	6/9[d]	0.007 - 0.037	0.0035	0.011	0.054	0.037
Heptachlor epoxide	1/9[d]	0.002	0.0013	0.001	0.001	0.001
<u>Remainder of Site - Subsurface Soil</u>						
Lead	9/9	7.5 - 21.0	NA	13.1	17.4	17.4
Nitrate	4/7	3.99 - 7.05	3.36	3.89	8.62	7.05
Aldrin	1/7[e]	0.002	0.0014	0.001	0.001	0.001
delta-Benzenehexachloride	1/7[e]	0.010	0.0085	0.005	0.007	0.007
alpha-Chlordane	2/7[e]	0.060	0.004	0.015	1.1	0.060
gamma-Chlordane	2/7[f]	0.060 - 0.067	0.004	0.016	1.2	0.067
p,p'-DDE	3/7[e]	0.003 - 0.01	0.0027	0.003	0.009	0.009
p,p'-DDT	2/7[e]	0.007 - 0.008	0.0035	0.003	0.008	0.008

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (USEPA 1989).
[c]Not applicable.
[d]Four sample results were not included in the calculations due to high CRLs.
[e]Nine sample results were not included in the calculations due to high CRLs.
[f]Seven sample results were not included in the calculations due to high CRLs.

Table 4-39. Selection of Chemicals of Potential Concern for Soil-related Pathways Based on EPA Region III's Soil Screening Guidance (SWMU 35)

	EPA[a] Region III RBC[b] Screen			
	Residential RBCs (μg/g)[c]			
Chemical	Ingestion	Inhalation	Exposure Point Conc. (μg/g)	Retained as COPC[d]?
Surface Soil - Ditches West of Stable Area				
Lead	400[e]	NA[f]	77.0	No
Copper	310	NA	28.0	No
Zinc	2,300	NA	120	No
Aldrin	0.038	0.5	0.018	No
beta-Benzenehexachloride	0.35	16	0.160	No
delta-Benzenehexachloride	0.035[g]	16[g]	2.40	**YES**
alpha-Chlordane	0.49	10	10.0	**YES**
gamma-Chlordane	0.49	10	10.0	**YES**
p,p′-DDD	2.7	37	0.110	No
p,p′-DDE	1.9	10	1.30	No
p,p′-DDT	1.9	80	0.075	No
Dieldrin	0.04	2	0.034	No
alpha-Endosulfan	47[h]	0.1[h]	0.380	**YES**
beta-Endosulfan	47[h]	0.1[h]	0.018	No
Endosulfan sulfate	47[h]	0.1[h]	0.037	No
Endrin	2.3	1.6	4.0	**YES**
Endrin aldehyde	2.3[i]	1.6[i]	0.016	No
Endrin ketone	2.3[i]	1.6[i]	0.009	No
Heptachlor	0.14	0.3	0.150	**YES**
Heptachlor epoxide	0.07	1	0.250	**YES**
Lindane (gamma-BHC)	0.49	4.2	0.041	No
Surface Soil - Remainder of Site				
Arsenic	0.43	380	31.1	**YES**
Cadmium	3.9	920	1.36	No
Cobalt	470	NA	7.80	No
Lead	400[e]	NA	101	No
Nitrate	13,000	NA	23.0	No
Zinc	2,300	NA	150	No
Butyl benzyl phthalate	1,600	53	0.297	No
alpha-Chlordane	0.49	10	0.004	No
gamma-Chlordane	0.49	10	0.003	No
p,p′-DDD	2.7	37	0.004	No
p,p′-DDE	1.9	10	0.062	No
p,p′-DDT	1.9	80	0.037	No
Heptachlor epoxide	0.07	1	0.001	No
Remainder of Site - Subsurface Soil				
Lead	400[e]	NA	17.4	No
Nitrate	13,000	NA	7.05	No

Table 4-39. Selection of Chemicals of Potential Concern for Soil-related Pathways Based on EPA Region III's Soil Screening Guidance (SWMU 35) (continued)

	EPA[a] Region III RBC[b] Screen			
	Residential RBCs (μg/g)[c]			
Chemical	**Ingestion**	**Inhalation**	**Exposure Point Conc. (μg/g)**	**Retained as COPC[d]?**
Aldrin	0.038	0.5	0.001	No
alpha-Chlordane	0.49	10	0.060	No
gamma-Chlordane	0.49	10	0.067	No
p,p′-DDE	1.9	10	0.009	No
p,p′-DDT	1.9	80	0.008	No

Note.—RBCs were taken directly from the Region III RBC Table (USEPA 1995), except as noted in the footnotes. Values for noncarcinogens are 1/10 of the Region III RBC.

[a]U.S. Environmental Protection Agency.
[b]Risk-based calculations.
[c]Micrograms per gram.
[d]Chemicals of potential concern.
[e]OSWER recommended clean-up level for lead in residential soil (USEPA, 1994).
[f]Not applicable.
[g]Value for beta-BHC.
[h]Value for endosulfan.
[i]Value for endrin.

Table 4-40. SWMU-Wide Surface Soil Exposure Point Concentrations of Chemicals of Potential Concern (SWMU 35)

Chemical	Frequency of Detection[a]	Range of Detected Values (μg/g)[b]	Range of Reporting Limits (μg/g)	Arithmetic Mean Concentration (μg/g)	95% UCL[c] Concentration (μg/g)	Exposure Point Concentration[d] (μg/g)
Arsenic	4/5[e]	15.6 - 32.0	24.0	19.0	31.1	31.1
delta-Benzenehexachloride	2/19	0.039 - 2.4	0.0085 - 0.29	0.021	1.27	1.27
alpha-Chlordane	6/19	0.009 - 10.0	0.004 - 1.0	0.296	90.5	10.0
gamma-Chlordane	6/14	0.007 - 10.0	0.004	0.191	34.9	10.0
alpha-Endosulfan	4/13[f]	0.003 - 0.38	0.001	0.008	0.17	0.17
Endrin	4/19	0.019 - 4.0	0.0065 - 0.41	0.25	4.7	4.0
Heptachlor	1/19	0.15	0.0022 - 0.28	0.08	2.2	0.15
Heptachlor epoxide	5/19	0.002 - 0.25	0.0013 - 0.36	0.147	7.7	0.25

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]Micrograms per gram.
[c]Upper confidence limit.
[d]The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
[e]Five samples were not included in the calculations due to high CRLs.
[f]Six samples were not included in the calculations due to high CRLs.

particulate-bound COPCs. With entrainment, it is assumed that small amounts of the organic compounds or heavy metals become airborne and adsorbed onto the surface of dust particles.

A volatilization emission analysis was performed (SEC Donahue 1992b) using a volatilization release estimation equation designed for chemicals spilled or incorporated into soils (USEPA 1988a). Results from this analysis indicated negligible air quality impacts derived from volatilization releases from SWMUs located at TEAD. In addition, results from previous modeling conducted for adjacent sites with similar VOC concentrations revealed insignificant releases (SEC Donahue 1992b).

For current and future on-site receptors, COPCs retained for the soil pathways were used to evaluate exposures from air. For current off-site receptors, exposure point concentrations generated for COPCs retained for the on-site soil pathways were modeled using SCREEN2 to estimate the air quality impacts at selected sites surrounding TEAD. To maintain a health-protective approach, the RME EPC for children was used as the input soil concentration to the model. Off-site air concentrations generated by the model were screened against USEPA Region III Risk-Based Concentrations guidance to verify the negligible contribution of this pathway. SCREEN2 is a single-source, screening-level model that has algorithms to estimate air quality impacts associated with air sources. For a complete description of the SCREEN2 model and associated results, see Appendix N. As shown in Table 4-41, based on comparison to air RBC, no COPCs were retained for quantitative off-site evaluation.

4.3.4.3 *Selection of Chemicals of Potential Concern - Groundwater*

The selection of COPCs for the groundwater exposure pathways consist of a two-phase modeling approach. Initially, the *maximum* concentration of each analyte detected in either surface or subsurface soil was compared to the Region III soil-to-groundwater RBC. One-tenth of the value was used for noncarcinogens. If the maximum concentration of a chemical exceeded the soil-to-groundwater RBC, the chemical was selected for vadose zone modeling (Table 4-42). The modeled break-through concentration in groundwater for these chemicals was then compared to the Region III tap water RBCs, with one-tenth of the value used for noncarcinogens. In addition, the modeled break-through time was compared to the 100-year cut-off period as described in Section 2.7.2. A chemical that reached the water table within 100 years *and* had a modeled break-through concentration that exceeded the Region III tap water RBC (one-tenth of the value for noncarcinogens) was retained for further vadose-saturated zone modeling to on- and off-site hypothetical receptors as described in Section 2.7.2. For this second phase of modeling, the *average* surface and subsurface soil concentration was used to calculate the initial pore water concentration at the site. Again, the vadose-saturated zone modeling results were compared to the Region III tap water RBCs, with one-tenth for noncarcinogens. If the chemical still failed to meet the 100-year break-through criteria *and* exceeded the Region III tap water RBC, it was retained for quantitative risk assessment. As shown in Table 4-42, arsenic, cadmium, lead, nitrate, aldrin, beta- and delta-benzenehexachloride, alpha- and gamma-chlordane, DDE, dieldrin, alpha-endosulfan, endrin, heptachlor, heptachlor epoxide, and lindane were retained for vadose modeling at SWMU 35.

Table 4-41. Selection of Chemicals of Potential Concern for Off-site Air-related Pathways Based on EPA Region III's Risk-Based Concentration Screening Guidance (SWMU 35)

		EPA Region III Risk-Based Concentration[a] Screen ($\mu g/m^3$)[b]					
Chemical	**RME SWMU-wide Soil Exposure Point Conc. (mg/kg)[c]**	**Exposure Point Conc. at Property Line**	**Exposure Point Conc. at Grantsville**	**Exposure Point Conc. at Tooele**	**Exposure Point Conc. at Stockton**	**Ambient Air RBC**	**Retained as off-site COPC[d]?**
Arsenic	31.1	0.00096	0.00012	0.00044	0.00031	0.00041	No[e]
delta-Benzenehexachloride[f]	0.028	0.00000086	0.00000011	0.00000039	0.00000028	0.0035	No
alpha-Chlordane[g]	2.93	0.000090	0.000011	0.000041	0.000029	0.0049	No
gamma-Chlordane[g]	2.93	0.000090	0.000011	0.000041	0.000029	0.0049	No
alpha-Endosulfan[h]	0.00034	0.000000011	0.0000000013	0.0000000048	0.0000000033	2.2	No
Endrin	0.52	0.000016	0.0000020	0.0000073	0.0000051	0.11	No
Heptachlor	0.00018	0.0000000055	0.00000000070	0.0000000025	0.0000000018	0.0014	No
Heptachlor epoxide	0.03	0.00000092	0.00000012	0.00000042	0.00000029	0.00069	No

[a]Values for noncarcinogens are 1/10th of the Region III RBC (USEPA 1996).
[b]Micrograms per cubic meter.
[c]Milligrams per kilogram.
[d]Chemicals of potential concern.
[e]Arsenic was not retained since the higher EPC for the on-site resident (.0015 $\mu g/m^3$) did not result in a risk exceeding USEPA or State of Utah criteria.
[f]RBC value for technical-benzenehexachloride used in lieu of specific information for the delta-isomer.
[g]RBC value for chlordane used in lieu of specific information for the alpha-isomer.
[h]RBC value for endosulfan used in lieu of specific information for the alpha-isomer.

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Table 4-42. Selection of COPCs for Groundwater Exposure Pathways (SMWU 35)

Chemical	Maximum Above Background	Depth	Soil-to-GW[b] RBC[c] (μg/g)	Selected for Vadose Zone Modeling?	Reached the Water Table Within 100 Years	Model Output: Break-through Point Concentration in Ground Water (mg/L)[d]	Tap Water RBC (mg/L)	Selected as COPC[e] for Groundwater[f]?
Arsenic	32.0	Surface	15	YES	No	---[g]	---	No
Barium	---[h]	---	---	---	---	0.0445[h]	0.260	No
Cadmium	1.43	Surface	0.6	YES	No	---	---	No
Cobalt	7.8	Surface	119[i]	No	---	---	---	---
Copper	28.0	Surface	31[i]	No	---	---	---	---
Lead	130	Surface	15	YES	No	---	---	No
Nitrate	23	Surface	2.0[i]	YES	No	---	---	No
Zinc	200	Surface	4,200	No	---	---	---	---
Aldrin	0.018	Surface	0.005	YES	No	---	---	No
beta-Benzenehexachloride	0.16	Surface	0.002	YES	No	---	---	No
delta-Benzenehexachloride	2.4	Surface	0.002[j]	YES	No	---	---	No
Butyl benzyl phthalate	0.52	Surface	6.8	No	---	---	---	---
alpha-Chlordane	10.0	Surface	2.0	YES	No	---	---	No
gamma-Chlordane	10.0	Surface	2.0	YES	No	---	---	No
p,p′-DDD	0.11	Surface	0.7	No	---	---	---	---
p,p′-DDE	1.3	Surface	0.5	YES	No	---	---	No
p,p′-DDT	0.0752	Surface	1.0	No	---	---	---	---
Dieldrin	0.0335	Surface	0.001	YES	No	---	---	No
alpha-Endosulfan	0.38	Surface	0.3	YES	No	---	---	No
beta-Endosulfan	0.018	Surface	0.3	No	---	---	---	---
Endosulfan sulfate	0.037	Surface	0.3	No	---	---	---	---
Endrin	4.0	Surface	0.04	YES	No	---	---	No
Endrin aldehyde	0.016	Surface	0.04[k]	No	---	---	---	---
Endrin ketone	0.0093	Surface	0.04[k]	No	---	---	---	---
Heptachlor	0.15	Surface	0.06	YES	No	---	---	No
Heptachlor epoxide	0.25	Surface	0.03	YES	No	---	---	No
Lindane	0.0408	Surface	0.006	YES	No	---	---	No

Note.—RBCs were taken directly from the Region III RBC Table except as indicated in the footnotes.
[a]Micrograms per gram.
[b]Groundwater.
[c]Risk-based concentrations.
[d]Milligrams per liter; values taken from Table 4-39.
[e]Chemicals of potential concern.
[f]Eliminated as a groundwater COPC if the chemical reached the water table in more than 100 years or did not exceed the tap water RBC.
[g]Not applicable; vadose zone modeling showed that the chemical breakthrough time to the water table is greater than 100 years.
[h]Barium was not detected above background in soil. Value is groundwater concentration from water supply well WW-1 (filtered).
[i]Calculated according to Region III guidance (US EPA, 1995).
[j]Value for beta-benzenehexachloride.
[k]Value for endrin.

4.3.4.3.1 ***Vadose Zone Model Results.*** The soil screening described in the previous sections indicated that 16 COPCs should be evaluated using the soil-vadose-zone-groundwater screening model at SWMU 35. These COPCs consist of the 3 metals, nitrate, and 12 pesticides as indicated in Table 4-42. The vadose modeling set-up procedures are described in detail in Section 2.7.2 of this report. This section defines the site-specific parameters and presents the vadose zone modeling results.

The SWMU 35 site-specific input parameters are defined as the vadose zone thickness (H cm), the area of contamination (CA m^2), and the thickness of the contaminated zone (H cont, cm). These input parameters, along with the COPC chemical-specific parameters, are used as the input for the GWM-1 and MULTIMED models. The GWM-1 spreadsheets for SWMU 35 are shown in Appendix K. As these figures in Appenidx K indicate, the above site-specific parameters for SWMU 35 are as follows:

H	=	10,668 cm
CA	=	142,650 m^2
H cont	=	30.48 cm

Other key COPC specific parameters—the distribution coefficient (Kd), the maximum observed soil concentration (Tc), the initial pore water concentration (C_{init}), and the plume pulse duration (p.d.)—are also shown in Appendix K. All of the GWM-1 spreadsheets associated with the site-specific COPCs are in Appendix K along with the MULTIMED output concentrations. Table 4-43 summarizes these COPC specific parameters and shows the MULTIMED output for COPC break-through time (the time after leaching starts that the leading edge of the COPC plume reaches the top of the water table) along with the COPC estimated concentration at the time that break through occurs. One key to interpreting these estimates is that the pore water concentration was determined by starting with the maximum observed soil concentration measured at the site (see Table 4-42) and calculating the maximum concentration available for the pore water solution by soil-water partitioning. As explained in Section 2.7.2, the equation used is very dependent on Kd and does not take into account mineral solubility and equilibrium relationships. This is evident by some of the high C_{init} concentrations estimated for the several of the COPCs.

4.3.4.3.2 ***Groundwater COPCs.*** As shown in the previous sections and in Table 4-43, the MULTIMED output indicates that within a 100-year time period none of the SWMU 35 COPCs will travel downward through the vadose zone and reach the water table. As discussed in detail in Section 2.7.2, the conservative approach was the basis for the model calculations.

Table 4-43 summarizes the COPCs and shows the critical input and output parameters, the estimated break-through time for each COPC, and the estimated concentration associated with the arrival of the leading edge of the COPC plume at the water table. Again, it should be noted that the break-through time calculation does not take into account the various retardation

Table 4-43. Summary of Break-Through Vadose Zone Modeling Results and Critical I/O GWM-1 and MULTIMED Parameters for SWMU 35

COPC Specific Parameters						
Analyte	Kd[a]	Tc (max)[b] (ppm)	C_{init}[c] (mg/L)	Breakthrough Time (yrs)	Breakthrough Conc. (mg/L)	p.d.[d] (yrs)
Arsenic	1	32	32	850	0.139	6
Cadmium	1.3	1.43	1.13	1,050	0.0019	7
Lead	4.5	130	3.13	3,400	0.0087	24
Nitrate	1	23	23	850	0.0999	6
Aldrin	1600	0.018	0.0000125	>91,000	ND[e]	8,397
beta-Benzenehexachloride	1.45	0.16	0.114	1,150	0.00013	8
delta-Benzenehexachloride	1	2.4	2.4	800	0.0083	6
alpha-Chlordane	500	10	0.022	>91,000	ND	2,625
gamma-Chlordane	500	10	0.022	>91,000	ND	2,625
p,p'-DDE	500	1.3	0.0029	>91,000	ND	2,625
Dieldrin	17.5	0.0335	0.0021	14,100	0.000013	92
alpha-Endosulfan	1.02	0.38	0.37	850	0.0012	6
Endrin	4.16	4	1.04	3,600	0.0102	22
Heptachlor	11	0.15	0.015	10,100	0.00021	58
Heptachlor epoxide	10.5	0.25	0.026	8,100	0.00007	56
Lindane	1	0.0408	0.0408	500	0.00049	6

Note.—Site-specific parameters are as follows: vadose zone thickness (H) = 10,668 cm; area of contaminated soil (CA) = 142,650 m^2; thickness of contaminated soil (Hcont) = 30.48 cm.

[a]The distribution coefficient and is dimensionless.
[b]The maximum observed soil concentration (ppm).
[c]The pore water concentration at the source as conservatively calculated by GWM-1.
[d]The pulse duration as calculated by GWM-1.
[e]Not determined.

influences, such as biodegradation, volatilization, absorption, adsorption, and mineral-solution equilibrium.

In summary, the COPCs ranged in break-through time from 500 years for lindane to over 91,000 years for aldrin, alpha-chlordane, gamma chlordane, and p,p'-DDE. No chemicals were demonstrated to break through before 100 years. However, barium was detected in water supply well WW-1 associated with this SWMU. Therefore, the barium concentration in the sample collected from WW-1 was compared to the Region III tap water RBC. Since the barium concentration was less than the tap water RBC, barium was also eliminated as a groundwater COPC for SWMU 35.

4.3.4.4 *Exposure Pathway Assessment*

Exposure is defined as the contact of a receptor with a chemical (USEPA 1989c). Exposure assessment is the estimation of the magnitude, frequency, and duration for each identified route of exposure. The magnitude of an exposure is determined by estimating the amount of chemical available at the receptor exchange boundaries (i.e., lungs, gastrointestinal tract, or skin) during a specified time period. Section 3.1.2 describes the general tasks comprising the exposure assessment. The specific application of these tasks to SWMU 35 is described below.

4.3.4.4.1 ***Characterization of Exposure Setting.*** The first step in developing exposure scenarios for SWMU 35 was to characterize the SWMU setting in which potential exposures might occur. The characteristics of the site setting influence the types of transport mechanisms and the type of receptor exposure that could occur. The site setting also provides a basis for identifying the potential receptors (either real or, in the case of site redevelopment for alternative use, hypothetical). Both current land use patterns and future land use patterns were examined as part of the characterization.

Current Land Use. As is true for other areas of TEAD, public access to SWMU 35 is controlled, thereby precluding transient exposure. On-base housing for both civilians and military families is located in the administrative area of TEAD, adjacent to SWMU 35. There are 17 military personnel with 17 dependents and 20 civilian personnel with 42 dependents currently living in on-base housing, for a total of 96 people. The average residence time is approximately 3 years (S. Culley, personal communication with Rust E&I, 1994). In addition, the depot stables are located immediately east of the area defined as SWMU 35 (see Figure 4-7).
Based on the above information, potential receptors under current land use were defined as:

- Depot staff—Primarily military and civilian office staff in the main depot complex.

- SWMU-specific laborers and security personnel—Individuals with job descriptions that call for repeated, moderate to heavy labor in the general vicinity of SWMU 35 and

staff assigned to maintenance of the SWMU perimeter or security personnel that repeatedly work in the vicinity of SWMU 35.

- Installation residents—Military and civilian personnel and dependents living on the depot and students and employees of Tooele Alternative High School.

Because other potential receptors would be exposed only intermittently to SWMU 35, SWMU-specific laborers and security personnel were the only receptors evaluated quantitatively as a current-use scenario. This approach provides a series of upper-bound estimates.

Future Land Use. Under the current BRAC plan, 1,700 acres comprising the maintenance and administrative areas of the depot were scheduled to be turned over to the TCEDC in 1995 through an interim lease (HOH Associates 1995). To date, none of the 1,700 acres have been turned over. The Tooele County EDA is in the process of preparing an application for an EDC of the entire 1,700-acre parcel. In the interim, the Army is pursuing the interim lease of a number of facilities in cooperation with the EDA. To date, several buildings have been leased and several others are pending. The open storage lots, however, remain vacant and are no longer in use.

Some 390 of these 1,700 acres are undeveloped, including approximately 122 acres that are adjacent to SWMU 35. The TCEDC plan indicates that these currently undeveloped areas will be converted to public access recreational use (e.g., golf course, playground, park, and open spaces). Extensive residential development is not expected in the near-term and, if it occurs at all, may not occur until property transfer is finalized. The remaining acreage is planned to continue as an industrial-use complex to be incorporated into the Tooele Industrial Park.

Based on this information, some exposure scenarios that are analogous to current-use scenarios described above will continue (e.g., depot staff). Therefore, three additional exposure scenarios unique to planned or potential future use of SWMU 35 were developed:

- Skilled laborers—Individuals assigned to short-term construction in the vicinity of SWMU 35 during potential redevelopment.

- Recreational users—Individuals who may play golf or use the park and open spaces for other recreational or sporting activities, depending on actual redevelopment.

- Inhabitants of an on-site residence(s)—Individuals who live in residences established at the time that depot property is transferred for redevelopment.

4.3.4.4.2 ***Characterization of Potential Exposure Pathways***. An exposure pathway is the route COPCs take to reach potential receptors. Sections 3.1.2.1 and 3.1.2.2 describe the methodology for characterization of exposure pathways. This methodology was then applied to SWMU 35. The following sections describe the potential exposure pathways associated with SWMU 35 for the current and future land use scenarios.

Current Land Use. Currently, the majority of laborers at TEAD work 10-hour days with 4-day weeks. It is assumed that laborers have a total of 4 weeks off a year for vacation, holidays, and sick leave, which yields 192 days per year on the job. It is also assumed that a laborer could be at any specific SWMU from 2 to 10 hours per day and will incidentally ingest, inhale, or become in contact with surface soil through worker-related activities. Military personnel are rotated on assignment an average of every 3 years (S. Culley, personal communication with Rust E&I, 1994). If a laborer is a civilian, the length of assignment could be expected to range as high as 25 years. It is assumed that all of the exposure is from outdoor tasks or activities. Specific parameters relating to ingestion, contact, and ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

Future Land Use. Land associated with SWMU 35 may be used at some future time for public access for recreational use or residential development. Based on this assumption, the future on-site adult and child resident and recreational visitor are evaluated for the future land use scenario. Skilled laborers, such as construction workers, were not evaluated for this scenario since there were no COPCs in subsurface soils that were at concentrations above the USEPA's soil screening levels.

For the future on-site adult resident, it was assumed that at least one parent would spend much of his or her time away from home in activities such as working at another location, household errands, personal care (e.g., medical/dental appointments), or leisure activities. Based on this assumption, the total estimated time an adult will spend at home is approximately 15 to 19 hours per day during which time he or she may incidentally ingest, inhale, or come in contact with surface soil while conducting activities such as gardening, mowing, or outdoor sports. It is also expected that the future on-site resident will grow and harvest vegetables and fruits from a home garden. For children and adolescents ages 0 to 18, time activity patterns indicate that they spend an average of approximately 30 hours per week away from home to attend school or day care. The total time a child spends at home, averaged over a 7-day week, is approximately 20 hours per day. It is assumed that residents spend 2 (RME) to 4 (CTE) weeks away from home on vacation or long holiday weekends. Therefore, the exposure frequency in real time is 335 days per year (CTE) to 350 days per year (RME). Because the contact rate for ingestion and dermal exposure is in daily units, the exposure frequency for these pathways is prorated into 24-hour-day equivalents. This ranges from 216 days per year (CTE adult) to 276 days per year (CTE child) and from 273 days per year (RME adult) to 288 days per year (RME child) (see Appendix L). Years spent at one residence for the adult/child range from 8 (CTE) to 30 (RME) years based on studies compiled by the USEPA (1989c) and AIHC (1994). Specific parameters relating to ingestion, contact, ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

The potential future on-site recreational visitor, such as a golfer, may incidentally ingest, come in contact with, or inhale surface soil. For the CTE scenario, it is assumed that the visitor or golfer plays 9 holes for an average duration of 2.5 hours once every 2 weeks. For the RME scenario, the golfer plays for approximately 4.5 hours once a week. Specific parameters relating to ingestion, contact, and ventilation rates, body weights, and absorption or bioavailability are given in Appendix L. It is assumed that the visitor resides in the area from

8 (CTE) to 30 (RME) years based on studies compiled by the USEPA (1989c) and AIHC (1994).

4.3.4.4.3 *Exposure Point Concentrations.* The EPC is defined as the concentration of a COPC in an exposure medium that will be contacted over a real or hypothetical exposure duration. EPCs at SWMU 35 were evaluated for current and future use. Estimation of EPCs is fully described in Appendix L. For brevity, only information specific to SWMU 35 is presented in the following sections.

As discussed in Sections 4.3.4.1 and 4.3.4.2, the ditches west of the stable area portion of SWMU 35 are evaluated separately due to physical anomalies which distinguish this area from the remainder of the SWMU. Based on the screening methodology, EPCs were estimated for COPCs in surface soils for the ditches west of the stable area, the remainder of the SWMU, and the SWMU as a whole.

Current Land Use. EPCs for surface soil ingestion and dermal contact by the SWMU 35 personnel were estimated for the CTE and RME exposure scenario using Phase I and II Remedial Investigation data. Because the duties of on-site personnel vary, EPCs were developed for each area of concern and the SWMU, as a whole, to encompass all potential exposure scenarios for this receptor.

EPCs in air for on-site personnel at SWMU 35 were estimated using USEPA's SCREEN2 model. Air emissions were not evaluated for each specific area of concern. It was assumed that the SWMU, as a whole, was the main source for air emission generation for all on- and off-site receptors. Details of the estimation of emission rates from surface soils and dispersion modeling are described in Appendix N.

Future Land Use. EPCs for surface soil ingestion, dermal contact, and produce ingestion by hypothetical future residents and recreational visitors at SWMU 35 were estimated using methods described in Appendix L. The EPCs are given in Tables 4-44 through 4-48. The EPCs for organics are based on the environmental half-life in soil and are estimated using the approach described in Appendix L, Section 1.1.

EPCs for inhalation of particulates were modeled, as described in Appendix N, for the hypothetical on-site residents and visitors. Air emissions were not evaluated for each specific area of concern. It was assumed that the SWMU, as a whole, was the main source for air emission generation for all on-site receptors. EPCs for ingestion of produce were modeled based on surface soil EPCs for the future on-site residents (Appendix L).

Table 4-44. Adult Exposure Point Concentrations for the Ditches West of the Stable Area of Concern Associated with SWMU 35

Chemical	Exposure Point Concentration	
	CTE	RME
Current Land Use		
Surface Soil (mg/kg)		
delta-Benzenehexachloride	0.044	0.038
alpha-Chlordane	3.47	2.17
gamma-Chlordane	3.47	2.17
alpha-Endosulfan	0.00009	0.00055
Endrin	0.11	0.37
Heptachlor	0.00019	0.00013
Heptachlor Epoxide	0.011	0.022
Air ($\mu g/m^3$)		
Arsenic	0.00152	0.00152
delta-Benzenehexachloride	0.00000112	0.000000975
alpha-Chlordane	0.000169	0.000106
gamma-Chlordane	0.000169	0.000106
alpha-Endosulfan	0.00000000195	0.0000000117
Endrin	0.00000536	0.000018
Heptachlor	0.00000000926	0.00000000634
Heptachlor Epoxide	0.000000536	0.00000107
Future Land Use [a]		
Surface Soil (mg/kg)		
delta-Benzenehexachloride	0.016	0.032
alpha-Chlordane	1.40	1.82
gamma-Chlordane	1.40	1.82
alpha-Endosulfan	0.000035	0.00046
Endrin	0.042	0.31
Heptachlor	0.00071	0.00011
Heptachlor Epoxide	0.0041	0.018
Air ($\mu g/m^3$)		
Arsenic	0.00152	0.00152
delta-Benzenehexachloride	0.000000439	0.000000827
alpha-Chlordane	0.0000683	0.0000887
gamma-Chlordane	0.0000683	0.0000887
alpha-Endosulfan	0.000000000975	0.00000000975
Endrin	0.00000195	0.0000151
Heptachlor	0.00000000341	0.00000000536
Heptachlor Epoxide	0.000000195	0.000000878
Tubers/Fruits (mg/kg)		
delta-Benzenehexachloride	0.0244	0.0472
alpha-Chlordane	0.137	0.178
gamma-Chlordane	0.000952	0.00124
alpha-Endosulfan	0.0000828	0.00107

Table 4-44. Adult Exposure Point Concentrations for the Ditches West of the Stable Area of Concern Associated with SWMU 35 (continued)

Chemical	Exposure Point Concentration	
	CTE	**RME**
Endrin	0.00895	0.0673
Tubers/Fruits (mg/kg) (continued)		
Heptachlor	0.00124	0.0000186
Heptachlor Epoxide	0.000811	0.00362
Leafy Vegetables (mg/kg)		
delta-Benzenehexachloride	0.000699	0.00135
alpha-Chlordane	0.00391	0.00509
gamma-Chlordane	0.0000272	0.0000354
alpha-Endosulfan	0.00000237	0.0000306
Endrin	0.000256	0.00192
Heptachlor	0.000000354	0.000000531
Heptachlor Epoxide	0.0000232	0.000103

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Table 4-45. Child Exposure Point Concentrations for the Ditches West of the Stable Area of Concern Associated with SWMU 35

	Exposure Point Concentration	
Chemical	**CTE**	**RME**
Future Land Use [a]		
Surface Soil (mg/kg)		
delta-Benzenehexachloride	0.016	0.053
alpha-Chlordane	1.40	2.93
gamma-Chlordane	1.40	2.93
alpha-Endosulfan	0.000035	0.00076
Endrin	0.042	0.52
Heptachlor	0.000071	0.00018
Heptachlor Epoxide	0.0041	0.03
Air ($\mu g/m^3$)		
Arsenic	0.00152	0.00152
delta-Benzenehexachloride	0.000000439	0.00000137
alpha-Chlordane	0.0000683	0.00014
gamma-Chlordane	0.0000683	0.00014
alpha-Endosulfan	0.000000000975	0.0000000166
Endrin	0.0000195	0.0000254
Heptachlor	0.00000000341	0.0000088
Heptachlor Epoxide	0.000000195	0.0015
Tubers/Fruits (mg/kg)		
delta-Benzenehexachloride	0.0244	0.079
alpha-Chlordane	0.137	0.29
gamma-Chlordane	0.000952	0.0020
alpha-Endosulfan	0.0000828	0.0018
Endrin	0.00895	0.11
Heptachlor	0.0000124	0.000031
Heptachlor Epoxide	0.000811	0.0060
Leafy Vegetables (mg/kg)		
delta-Benzenehexachloride	0.000699	0.0023
alpha-Chlordane	0.00391	0.0082
gamma-Chlordane	0.0000272	0.000057
alpha-Endosulfan	0.00000237	0.000051
Endrin	0.000256	0.0032
Heptachlor	0.000000354	0.00000088
Heptachlor Epoxide	0.0000232	0.00017

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Table 4-46. Adult Exposure Point Concentrations for the Remainder of SWMU 35 Not Including Areas of Concern

Chemical	Exposure Point Concentration	
	CTE	RME
Current Land Use		
Surface Soil (mg/kg)		
Arsenic	31.1	31.1
Air ($\mu g/m^3$)		
Arsenic	0.00152	0.00152
delta-Benzenehexachloride	0.00000112	0.000000975
alpha-Chlordane	0.000169	0.000106
gamma-Chlordane	0.000169	0.000106
alpha-Endosulfan	0.00000000195	0.0000000117
Endrin	0.00000536	0.000018
Heptachlor	0.00000000926	0.00000000634
Heptachlor Epoxide	0.000000536	0.00000107
Future Land Use [a]		
Surface Soil (mg/kg)		
Arsenic	31.1	31.1
Air ($\mu g/m^3$)		
Arsenic	0.00152	0.00152
delta-Benzenehexachloride	0.000000439	0.000000827
alpha-Chlordane	0.0000683	0.0000887
gamma-Chlordane	0.0000683	0.0000887
alpha-Endosulfan	0.000000000975	0.00000000975
Endrin	0.00000195	0.0000151
Heptachlor	0.00000000341	0.00000000536
Heptachlor Epoxide	0.000000195	0.0000000878
Tubers/Fruits (mg/kg)		
Arsenic	0.041	0.041
Leafy Vegetables (mg/kg)		
Arsenic	0.087	0.087

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Table 4-47. Child Exposure Point Concentrations for the Remainder of SWMU 35 Not Including Areas of Concern

Chemical	Exposure Point Concentration CTE	RME
Future Land Use [a]		
Surface Soil (mg/kg)		
Arsenic	31.1	31.1
Air ($\mu g/m^3$)		
Arsenic	0.00152	0.00152
delta-Benzenehexachloride	0.000000439	0.00000137
alpha-Chlordane	0.0000683	0.00014
gamma-Chlordane	0.0000683	0.00014
alpha-Endosulfan	0.000000000975	0.0000000166
Endrin	0.00000195	0.0000254
Heptachlor	0.00000000341	0.0000088
Heptachlor Epoxide	0.000000195	0.0015
Tubers/Fruits (mg/kg)		
Arsenic	0.041	0.041
Leafy Vegetables (mg/kg)		
Arsenic	0.087	0.087

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Table 4-48. Adult Exposure Point Concentrations for the SWMU 35 as a Whole

Chemical	Exposure Point Concentration CTE	Exposure Point Concentration RME
Current Land Use		
Surface Soil (mg/kg)		
Arsenic	31.1	31.1
delta-Benzenehexachloride	0.023	0.020
alpha-Chlordane	3.47	2.17
gamma-Chlordane	3.47	2.17
alpha-Endosulfan	0.000042	0.00024
Endrin	0.111	0.37
Heptachlor	0.00019	0.00013
Heptachlor Epoxide	0.011	0.022
Air ($\mu g/m^3$)		
Arsenic	0.00152	0.00152
delta-Benzenehexachloride	0.00000112	0.000000975
alpha-Chlordane	0.000169	0.000106
gamma-Chlordane	0.000169	0.000106
alpha-Endosulfan	0.00000000195	0.0000000117
Endrin	0.00000536	0.0000180
Heptachlor	0.00000000926	0.00000000634
Heptachlor Epoxide	0.000000536	0.00000107
Future Land Use [a]		
Surface Soil (mg/kg)		
Arsenic	31.1	31.1
delta-Benzenehexachloride	0.0087	0.017
alpha-Chlordane	1.40	1.82
gamma-Chlordane	1.40	1.82
alpha-Endosulfan	0.000016	0.00020
Endrin	0.042	0.31
Heptachlor	0.000071	0.00011
Heptachlor Epoxide	0.0041	0.018
Air ($\mu g/m^3$)		
Arsenic	0.00152	0.00152
delta-Benzenehexachloride	0.000000439	0.000000827
alpha-Chlordane	0.0000683	0.0000887
gamma-Chlordane	0.0000683	0.0000887
alpha-Endosulfan	0.000000000975	0.00000000975
Endrin	0.00000195	0.0000151
Heptachlor	0.00000000341	0.00000000536
Heptachlor Epoxide	0.000000195	0.000000878

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

4.3.4.4.4 *Estimation of Chemical Intakes.* The exposure models described in detail in Appendix L together with EPCs listed in Tables 4-44 through 4-48 were used to estimate intake for the potential exposure scenarios. It should be noted that averaging times differ for carcinogens and noncarcinogens. Because exposure to soil is likely to be higher for young children and adolescents ages 0 to 18 years, intakes were calculated separately from the adults. Estimates of exposure intakes are given in Tables 4-49 through 4-64 in the following sections.

4.3.4.5 *Toxicity Assessment*

Information of the toxicological effects of carcinogenic and systemic toxicants are summarized in Appendix M. This toxicity assessment includes brief toxicity profiles on data listed in USEPA's IRIS database and published in HEAST (USEPA 1994c). These profiles describe the acute, chronic, and carcinogenic health effects associated with SWMU-related chemicals. Toxicity values for COPCs associated with SWMU 35 are summarized in Tables 4-49 through 4-64.

4.3.4.6 *Risk Characterization*

This section provides a characterization of the potential health risks associated with the intake of chemicals associated with SWMU 35. The risk characterization compares estimated potential ILCRs with reasonable levels of risk for potential carcinogens (see Section 3.1.4.1), and the estimated daily intake of systemic toxicants with appropriate reference levels. Some carcinogenic chemicals may also pose a systemic hazard, and these potential hazards are characterized as for other systemic toxicants. Each of the areas associated with SWMU 35—Ditches West of the Stable Area, remainder of SWMU, and SWMU 35 as a whole—are discussed separately below.

4.3.4.6.1 *Characterization of Potential Carcinogenic Risks.* The general process used to select the COPCs associated with SWMU 35 is described in Section 3.1.1.2. COPC selection for SWMU 35 is described in Section 4.3.4.2. For current and future land use scenarios, arsenic, delta-benzehexachloride, alpha-chlordane, gamma-chlordane, alpha-endosulfan, endrin, heptachlor, and heptachlor epoxide were identified as the COPCs. Arsenic is classified as a confirmed human carcinogen. Alpha-chlordane, gamma-chlordane, heptachlor, and heptachlor epoxide are classified as probable human carcinogens. The remaining COPCs are not classified. Tables 4-44 through 4-48 list the COPC and associated media.

<u>Ditches West of the Stable Area</u>

Current/Future On-Site Laborers. The cumulative ILCR for all pathways is 1.3E-06 and 2.5E-09 for the RME and CTE scenarios, respectively. As summarized in Table 4-49, the driving pathway is dermal contact with surface soil (47 percent) for the RME scenario and inhalation of particulates (43 percent) for the CTE scenario.

Table 4-49. Summary of Potenital Carcinogenic Risk Results for the Current/ Future On-site Laborer for SWMU 35 (Ditches West of the Stable Area)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Benzenehexachloride, delta-	4.4E-02	4.2E-12	1.8E+00	7.5E-12	
Chlordane, alpha-	3.5E+00	3.3E-10	1.3E+00	4.3E-10	
Chlordane, gamma-	3.5E+00	3.3E-10	1.3E+00	4.3E-10	
Endosulfan, alpha-	9.0E-05	NA(d)	NA	NA	
Endrin	1.1E-01	NA	NA	NA	
Heptachlor	1.9E-04	1.8E-14	4.5E+00	8.1E-14	
Heptachlor Epoxide	1.1E-02	1.0E-12	9.1E+00	9.5E-12	
			Pathway Total:	8.8E-10	35%
Dermal Contact with Surface Soil					
Benzenehexachloride, delta-	4.4E-02	2.1E-12	2.0E+00	4.1E-12	
Chlordane, alpha-	3.5E+00	1.7E-10	1.6E+00	2.7E-10	
Chlordane, gamma-	3.5E+00	1.7E-10	1.6E+00	2.7E-10	
Endosulfan, alpha-	9.0E-05	NA	NA	NA	
Endrin	1.1E-01	NA	NA	NA	
Heptachlor	1.9E-04	NA	NA	NA	
Heptachlor Epoxide	1.1E-02	NA	NA	NA	
			Pathway Total:	5.4E-10	22%
Inhalation of Particulates					
Arsenic	1.5E-06	6.9E-11	1.5E+01	1.0E-09	
Benzenehexachloride, delta-	1.1E-09	5.1E-14	1.8E+00	9.2E-14	
Chlordane, alpha-	1.7E-07	7.7E-12	1.3E+00	1.0E-11	
Chlordane, gamma-	1.7E-07	7.7E-12	1.3E+00	1.0E-11	
Endosulfan, alpha-	2.0E-12	NA	NA	NA	
Endrin	5.4E-09	NA	NA	NA	
Heptachlor	9.3E-12	4.2E-16	4.6E+00	1.9E-15	
Heptachlor Epoxide	5.4E-10	2.4E-14	9.1E+00	2.2E-13	
			Pathway Total:	1.1E-09	43%
			Total CTE ILCR:	2.5E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Benzenehexachloride, delta-	3.8E-02	2.9E-09	1.8E+00	5.2E-09	
Chlordane, alpha-	2.2E+00	1.7E-07	1.3E+00	2.1E-07	
Chlordane, gamma-	2.2E+00	1.7E-07	1.3E+00	2.1E-07	
Endosulfan, alpha-	5.5E-04	NA	NA	NA	
Endrin	3.7E-01	NA	NA	NA	
Heptachlor	1.3E-04	9.9E-12	4.5E+00	4.5E-11	
Heptachlor Epoxide	2.2E-02	1.7E-09	9.1E+00	1.5E-08	
			Pathway Total:	4.5E-07	34%
Dermal Contact with Surface Soil					
Benzenehexachloride, delta-	3.8E-02	3.4E-09	2.0E+00	6.6E-09	
Chlordane, alpha-	2.2E+00	1.9E-07	1.6E+00	3.1E-07	
Chlordane, gamma-	2.2E+00	1.9E-07	1.6E+00	3.1E-07	
Endosulfan, alpha-	5.5E-04	NA	NA	NA	
Endrin	3.7E-01	NA	NA	NA	
Heptachlor	1.3E-04	NA	NA	NA	
Heptachlor Epoxide	2.2E-02	NA	NA	NA	
			Pathway Total:	6.3E-07	47%
Inhalation of Particulates					
Arsenic	1.5E-06	1.7E-08	1.5E+01	2.5E-07	
Benzenehexachloride, delta-	9.8E-10	1.1E-11	1.8E+00	1.9E-11	
Chlordane, alpha-	1.1E-07	1.2E-09	1.3E+00	1.5E-09	
Chlordane, gamma-	1.1E-07	1.2E-09	1.3E+00	1.5E-09	
Endosulfan, alpha-	1.2E-11	NA	NA	NA	
Endrin	1.8E-08	NA	NA	NA	
Heptachlor	6.3E-12	7.0E-14	4.6E+00	3.2E-13	
Heptachlor Epoxide	1.1E-09	1.2E-11	9.1E+00	1.1E-10	
			Pathway Total:	2.5E-07	19%
			Total RME ILCR:	1.3E-06	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 4-50. Summary of Potential Carcinogenic Risk Results for the Future On-site Adult Resident for SWMU 35 (Ditches West of the Stable Area)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Benzenehexachloride, delta-	1.6E-02	1.4E-10	1.8E+00	2.5E-10	
Chlordane, alpha-	1.4E+00	1.2E-08	1.3E+00	1.6E-08	
Chlordane, gamma-	1.4E+00	1.2E-08	1.3E+00	1.6E-08	
Endosulfan, alpha-	3.5E-04	NA[d]	NA	NA	
Endrin	4.2E-02	NA	NA	NA	
Heptachlor	7.1E-04	6.2E-12	4.5E+00	2.8E-11	
Heptachlor Epoxide	4.1E-03	3.6E-11	9.1E+00	3.3E-10	
			Pathway Total:	3.3E-08	0.3%
Dermal Contact with Surface Soil					
Benzenehexachloride, delta-	1.6E-02	7.0E-11	2.0E+00	1.4E-10	
Chlordane, alpha-	1.4E+00	6.1E-09	1.6E+00	1.0E-08	
Chlordane, gamma-	1.4E+00	6.1E-09	1.6E+00	1.0E-08	
Endosulfan, alpha-	3.5E-04	NA	NA	NA	
Endrin	4.2E-02	NA	NA	NA	
Heptachlor	7.1E-04	NA	NA	NA	
Heptachlor Epoxide	4.1E-03	NA	NA	NA	
			Pathway Total:	2.0E-08	0.2%
Inhalation of Particulates					
Arsenic	1.5E-06	5.5E-09	1.5E+01	8.3E-08	
Benzenehexachloride, delta-	4.4E-10	1.6E-12	1.8E+00	2.9E-12	
Chlordane, alpha-	6.8E-08	2.5E-10	1.3E+00	3.2E-10	
Chlordane, gamma-	6.8E-08	2.5E-10	1.3E+00	3.2E-10	
Endosulfan, alpha-	9.8E-13	NA	NA	NA	
Endrin	2.0E-08	NA	NA	NA	
Heptachlor	3.4E-12	1.2E-14	4.6E+00	5.6E-14	
Heptachlor Epoxide	2.0E-10	7.1E-13	9.1E+00	6.5E-12	
			Pathway Total:	8.4E-08	0.7%
Ingestion of Leafy Vegetables					
Benzenehexachloride, delta-	7.0E-04	1.0E-08	1.5E+00	1.6E-08	
Chlordane, alpha-	3.9E-03	5.8E-08	1.3E+00	7.6E-08	
Chlordane, gamma-	2.7E-05	4.1E-10	1.3E+00	5.3E-10	
Endosulfan, alpha-	2.4E-06	NA	NA	NA	
Endrin	2.6E-04	NA	NA	NA	
Heptachlor	3.5E-07	5.3E-12	4.5E+00	2.4E-11	
Heptachlor Epoxide	2.3E-05	3.5E-10	9.1E+00	3.1E-09	
			Pathway Total:	9.5E-08	0.8%
Ingestion of Tubers and Fruits					
Benzenehexachloride, delta-	2.4E-02	1.2E-06	1.8E+00	2.2E-06	
Chlordane, alpha-	1.4E-01	6.9E-06	1.3E+00	8.9E-06	
Chlordane, gamma-	9.5E-04	4.8E-08	1.3E+00	6.2E-08	
Endosulfan, alpha-	8.3E-05	NA	NA	NA	
Endrin	9.0E-03	NA	NA	NA	
Heptachlor	1.2E-05	6.2E-10	4.5E+00	2.8E-09	
Heptachlor Epoxide	8.1E-04	4.1E-08	9.1E+00	3.7E-07	
			Pathway Total:	1.2E-05	98.0%
			Total CTE ILCR:	1.2E-05	100.0%

Table 4-50. Summary of Potential Carcinogenic Risk Results for the Future On-site Adult Resident for SWMU 35 (Ditches West of the Stable Area) (continued)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Benzenehexachloride, delta-	3.2E-02	6.7E-09	1.8E+00	1.2E-08	
Chlordane, alpha-	1.8E+00	3.8E-07	1.3E+00	4.9E-07	
Chlordane, gamma-	1.8E+00	3.8E-07	1.3E+00	4.9E-07	
Endosulfan, alpha-	4.6E-04	NA	NA	NA	
Endrin	3.1E-01	NA	NA	NA	
Heptachlor	1.1E-04	2.3E-11	4.5E+00	1.0E-10	
Heptachlor Epoxide	1.8E-02	3.7E-09	9.1E+00	3.4E-08	
			Pathway Total:	1.0E-06	0.4%
Dermal Contact with Surface Soil					
Benzenehexachloride, delta-	3.2E-02	7.7E-09	2.0E+00	1.5E-08	
Chlordane, alpha-	1.8E+00	4.4E-07	1.6E+00	7.2E-07	
Chlordane, gamma-	1.8E+00	4.4E-07	1.6E+00	7.2E-07	
Endosulfan, alpha-	4.6E-04	NA	NA	NA	
Endrin	3.1E-01	NA	NA	NA	
Heptachlor	1.1E-04	NA	NA	NA	
Heptachlor Epoxide	1.8E-02	NA	NA	NA	
			Pathway Total:	1.5E-06	0.6%
Inhalation of Particulates					
Arsenic	1.5E-06	2.9E-08	1.5E+01	4.4E-07	
Benzenehexachloride, delta-	8.3E-10	1.6E-11	1.8E+00	2.9E-11	
Chlordane, alpha-	8.9E-08	1.7E-09	1.3E+00	2.2E-09	
Chlordane, gamma-	8.9E-08	1.7E-09	1.3E+00	2.2E-09	
Endosulfan, alpha-	9.8E-12	NA	NA	NA	
Endrin	1.5E-08	NA	NA	NA	
Heptachlor	5.4E-12	1.0E-13	4.6E+00	4.7E-13	
Heptachlor Epoxide	8.8E-10	1.7E-11	9.1E+00	1.5E-10	
			Pathway Total:	4.4E-07	0.19%
Ingestion of Leafy Vegetables					
Benzenehexachloride, delta-	1.4E-03	2.6E-07	1.8E+00	4.8E-07	
Chlordane, alpha-	5.1E-03	1.0E-06	1.3E+00	1.3E-06	
Chlordane, gamma-	3.5E-05	6.9E-09	1.3E+00	9.0E-09	
Endosulfan, alpha-	3.1E-05	NA	NA	NA	
Endrin	1.9E-03	NA	NA	NA	
Heptachlor	5.3E-07	1.0E-10	4.5E+00	4.7E-10	
Heptachlor Epoxide	1.0E-04	2.0E-08	9.1E+00	1.8E-07	
			Pathway Total:	2.0E-06	0.8%
Ingestion of Tubers and Fruits					
Benzenehexachloride, delta-	4.7E-02	3.1E-05	1.8E+00	5.6E-05	
Chlordane, alpha-	1.8E-01	1.2E-04	1.3E+00	1.5E-04	
Chlordane, gamma-	1.2E-03	8.2E-07	1.3E+00	1.1E-06	
Endosulfan, alpha-	1.1E-03	NA	NA	NA	
Endrin	6.7E-02	NA	NA	NA	
Heptachlor	1.9E-05	1.2E-08	4.5E+00	5.5E-08	
Heptachlor Epoxide	3.6E-03	2.4E-06	9.1E+00	2.2E-05	
			Pathway Total:	2.3E-04	97.9%
			Total RME ILCR:	2.4E-04	100.0%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 4-51. *Summary of Potential Carcinogenic Risk Results for the Future On-site Child Resident for SWMU 35 (Ditches West of the Stable Area)*

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] (mg/kg-day)$^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Benzenehexachloride, delta-	1.6E-02	6.4E-10	1.8E+00	1.1E-09	
Chlordane, alpha-	1.4E+00	5.6E-08	1.3E+00	7.2E-08	
Chlordane, gamma-	1.4E+00	5.6E-08	1.3E+00	7.2E-08	
Endosulfan, alpha-	3.5E-05	NA[d]	NA	NA	
Endrin	4.2E-02	NA	NA	NA	
Heptachlor	7.1E-05	2.8E-12	4.5E+00	1.3E-11	
Heptachlor Epoxide	4.1E-03	1.6E-10	9.1E+00	1.5E-09	
			Pathway Total:	1.5E-07	1%
Dermal Contact with Surface Soil					
Benzenehexachloride, delta-	1.6E-02	1.2E-10	2.0E+00	2.3E-10	
Chlordane, alpha-	1.4E+00	1.0E-08	1.6E+00	1.7E-08	
Chlordane, gamma-	1.4E+00	1.0E-08	1.6E+00	1.7E-08	
Endosulfan, alpha-	3.5E-05	NA	NA	NA	
Endrin	4.2E-02	NA	NA	NA	
Heptachlor	7.1E-05	NA	NA	NA	
Heptachlor Epoxide	4.1E-03	NA	NA	NA	
			Pathway Total:	3.4E-08	0%
Inhalation of Particulates					
Arsenic	1.5E-06	2.8E-08	1.5E+01	4.2E-07	
Benzenehexachloride, delta-	4.4E-10	8.2E-12	1.8E+00	1.5E-11	
Chlordane, alpha-	6.8E-08	1.3E-09	1.3E+00	1.7E-09	
Chlordane, gamma-	6.8E-08	1.3E-09	1.3E+00	1.7E-09	
Endosulfan, alpha-	9.8E-13	NA	NA	NA	
Endrin	2.0E-08	NA	NA	NA	
Heptachlor	3.4E-12	6.3E-14	4.6E+00	2.9E-13	
Heptachlor Epoxide	2.0E-10	3.6E-12	9.1E+00	3.3E-11	
			Pathway Total:	4.3E-07	2%
Ingestion of Leafy Vegetables					
Benzenehexachloride, delta-	7.0E-04	1.7E-08	1.8E+00	3.1E-08	
Chlordane, alpha-	3.9E-03	9.5E-08	1.3E+00	1.2E-07	
Chlordane, gamma-	2.7E-05	6.6E-10	1.3E+00	8.6E-10	
Endosulfan, alpha-	2.4E-06	NA	NA	NA	
Endrin	2.6E-04	NA	NA	NA	
Heptachlor	3.5E-07	8.6E-12	4.5E+00	3.9E-11	
Heptachlor Epoxide	2.3E-05	5.6E-10	9.1E+00	5.1E-09	
			Pathway Total:	1.6E-07	1%
Ingestion of Tubers and Fruits					
Benzenehexachloride, delta-	2.4E-02	2.0E-06	1.8E+00	3.6E-06	
Chlordane, alpha-	1.4E-01	1.1E-05	1.3E+00	1.4E-05	
Chlordane, gamma-	9.5E-04	7.7E-08	1.3E+00	1.0E-07	
Endosulfan, alpha-	8.3E-05	NA	NA	NA	
Endrin	9.0E-03	NA	NA	NA	
Heptachlor	1.2E-05	1.0E-09	4.5E+00	4.5E-09	
Heptachlor Epoxide	8.1E-04	6.6E-08	9.1E+00	6.0E-07	
			Pathway Total:	1.9E-05	96%
			Total CTE ILCR:	2.0E-05	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Benzenehexachloride, delta-	5.3E-02	2.3E-08	1.8E+00	4.2E-08	
Chlordane, alpha-	2.9E+00	1.3E-06	1.3E+00	1.7E-06	
Chlordane, gamma-	2.9E+00	1.3E-06	1.3E+00	1.7E-06	
Endosulfan, alpha-	7.6E-04	NA	NA	NA	
Endrin	5.2E-01	NA	NA	NA	
Heptachlor	1.8E-04	8.0E-11	4.5E+00	3.6E-10	

Table 4-51. Summary of Potential Carcinogenic Risk Results for the Future On-site Child Resident for SWMU 35 (Ditches West of the Stable Area) (continued)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Heptachlor Epoxide	3.0E-02	1.3E-08	9.1E+00	1.2E-07	
			Pathway Total:	3.5E-06	1%
Dermal Contact with Surface Soil					
Benzenehexachloride, delta-	5.3E-02	5.4E-09	2.0E+00	1.0E-08	
Chlordane, alpha-	2.9E+00	3.0E-07	1.6E+00	4.8E-07	
Chlordane, gamma-	2.9E+00	3.0E-07	1.6E+00	4.8E-07	
Endosulfan, alpha-	7.6E-04	NA	NA	NA	
Endrin	5.2E-01	NA	NA	NA	
Heptachlor	1.8E-04	NA	NA	NA	
Heptachlor Epoxide	3.0E-02	NA	NA	NA	
			Pathway Total:	9.8E-07	0%
Inhalation of Particulates					
Arsenic	1.5E-06	4.6E-08	1.5E+01	6.9E-07	
Benzenehexachloride, delta-	1.4E-09	4.1E-11	1.8E+00	7.4E-11	
Chlordane, alpha-	1.4E-07	4.3E-09	1.3E+00	5.6E-09	
Chlordane, gamma-	1.4E-07	4.3E-09	1.3E+00	5.6E-09	
Endosulfan, alpha-	1.7E-11	NA	NA	NA	
Endrin	2.5E-08	NA	NA	NA	
Heptachlor	8.8E-09	2.7E-10	4.6E+00	1.2E-09	
Heptachlor Epoxide	1.5E-06	4.4E-08	9.1E+00	4.0E-07	
			Pathway Total:	1.1E-06	0%
Ingestion of Leafy Vegetables					
Benzenehexachloride, delta-	2.3E-03	2.9E-07	1.8E+00	5.2E-07	
Chlordane, alpha-	8.2E-03	1.1E-06	1.3E+00	1.4E-06	
Chlordane, gamma-	5.7E-05	7.4E-09	1.3E+00	9.6E-09	
Endosulfan, alpha-	5.1E-05	NA	NA	NA	
Endrin	3.2E-03	NA	NA	NA	
Heptachlor	8.8E-07	1.1E-10	4.5E+00	5.1E-10	
Heptachlor Epoxide	1.7E-04	2.2E-08	9.1E+00	2.0E-07	
			Pathway Total:	2.1E-06	1%
Ingestion of Tubers and Fruits					
Benzenehexachloride, delta-	7.9E-02	3.4E-05	1.8E+00	6.1E-05	
Chlordane, alpha-	2.9E-01	1.2E-04	1.3E+00	1.6E-04	
Chlordane, gamma-	2.0E-03	8.6E-07	1.3E+00	1.1E-06	
Endosulfan, alpha-	1.8E-03	NA	NA	NA	
Endrin	1.1E-01	NA	NA	NA	
Heptachlor	3.1E-05	1.3E-08	4.5E+00	6.0E-08	
Heptachlor Epoxide	6.0E-03	2.6E-06	9.1E+00	2.4E-05	
			Pathway Total:	2.5E-04	97%
			Total RME ILCR:	2.5E-04	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 4-52. Summary of Potenital Carcinogenic Risk Results for the Current/Future On-site Laborer for SWMU 35 (Remainder of SWMU)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) (mg/kg-day)-1	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	3.1E+01	3.0E-09	1.5E+00	4.4E-09	
			Pathway Total:	4.4E-09	77%
Dermal Contact with Surface Soil					
Arsenic	3.1E+01	1.5E-10	1.5E+00	2.3E-10	
			Pathway Total:	2.3E-10	4%
Inhalation of Particulates					
Arsenic	1.5E-06	6.9E-11	1.5E+01	1.0E-09	
Benzenehexachloride, delta-	1.1E-09	5.1E-14	1.8E+00	9.2E-14	
Chlordane, alpha-	1.7E-07	7.7E-12	1.3E+00	1.0E-11	
Chlordane, gamma-	1.7E-07	7.7E-12	1.3E+00	1.0E-11	
Endosulfan, alpha-	2.0E-12	NA(d)	NA	NA	
Endrin	5.4E-09	NA	NA	NA	
Heptachlor	9.3E-12	4.2E-16	4.6E+00	1.9E-15	
Heptachlor Epoxide	5.4E-10	2.4E-14	9.1E+00	2.2E-13	
			Pathway Total:	1.1E-09	19%
			Total CTE ILCR:	5.7E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	3.1E+01	2.4E-06	1.5E+00	3.6E-06	
			Pathway Total:	3.6E-06	84%
Dermal Contact with Surface Soil					
Arsenic	3.1E+01	2.8E-07	1.5E+00	4.2E-07	
			Pathway Total:	4.2E-07	10%
Inhalation of Particulates					
Arsenic	1.5E-06	1.7E-08	1.5E+01	2.5E-07	
Benzenehexachloride, delta-	9.8E-10	1.1E-11	1.8E+00	1.9E-11	
Chlordane, alpha-	1.1E-07	1.2E-09	1.3E+00	1.5E-09	
Chlordane, gamma-	1.1E-07	1.2E-09	1.3E+00	1.5E-09	
Endosulfan, alpha-	1.2E-11	NA	NA	NA	
Endrin	1.8E-08	NA	NA	NA	
Heptachlor	6.3E-12	7.0E-14	4.6E+00	3.2E-13	
Heptachlor Epoxide	1.1E-09	1.2E-11	9.1E+00	1.1E-10	
			Pathway Total:	2.5E-07	6%
			Total RME ILCR:	4.2E-06	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 4-53. Summary of Potential Carcinogenic Risk Results for the Future On-site Adult Resident for SWMU 35 (Remainder of SWMU)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	3.1E+01	2.7E-07	1.5E+00	4.1E-07	
			Pathway Total:	4.1E-07	7.4%
Dermal Contact with Surface Soil					
Arsenic	3.1E+01	1.4E-08	1.5E+00	2.1E-08	
			Pathway Total:	2.1E-08	0.4%
Inhalation of Particulates					
Arsenic	1.5E-06	5.5E-09	1.5E+01	8.3E-08	
Benzenehexachloride, delta-	4.4E-10	1.6E-12	1.8E+00	2.9E-12	
Chlordane, alpha-	6.8E-08	2.5E-10	1.3E+00	3.2E-10	
Chlordane, gamma-	6.8E-08	2.5E-10	1.3E+00	3.2E-10	
Endosulfan, alpha-	9.8E-13	NA[d]	NA	NA	
Endrin	2.0E-08	NA	NA	NA	
Heptachlor	3.4E-12	1.2E-14	4.6E+00	5.6E-14	
Heptachlor Epoxide	2.0E-10	7.1E-13	9.1E+00	6.5E-12	
			Pathway Total:	8.4E-08	1.5%
Ingestion of Leafy Vegetables					
Arsenic	8.7E-02	1.3E-06	1.5E+00	2.0E-06	
			Pathway Total:	2.0E-06	35.2%
Ingestion of Tubers and Fruits					
Arsenic	4.1E-02	2.1E-06	1.5E+00	3.1E-06	
			Pathway Total:	3.1E-06	55.5%
			Total CTE ILCR:	5.6E-06	100.0%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	3.1E+01	6.5E-06	1.5E+00	9.7E-06	
			Pathway Total:	9.7E-06	12.5%
Dermal Contact with Surface Soil					
Arsenic	3.1E+01	7.5E-07	1.5E+00	1.2E-06	
			Pathway Total:	1.2E-06	1.5%
Inhalation of Particulates					
Arsenic	1.5E-06	2.9E-08	1.5E+01	4.4E-07	
Benzenehexachloride, delta-	8.3E-10	1.6E-11	1.8E+00	2.9E-11	
Chlordane, alpha-	8.9E-08	1.7E-09	1.3E+00	2.2E-09	
Chlordane, gamma-	8.9E-08	1.7E-09	1.3E+00	2.2E-09	
Endosulfan, alpha-	9.8E-12	NA	NA	NA	
Endrin	1.5E-08	NA	NA	NA	
Heptachlor	5.4E-12	1.0E-13	4.6E+00	4.7E-13	
Heptachlor Epoxide	8.8E-10	1.7E-11	9.1E+00	1.5E-10	
			Pathway Total:	4.4E-07	0.6%
Ingestion of Leafy Vegetables					
Arsenic	8.7E-02	1.7E-05	1.5E+00	2.6E-05	
			Pathway Total:	2.6E-05	33.1%
Ingestion of Tubers and Fruits					
Arsenic	4.1E-02	2.7E-05	1.5E+00	4.1E-05	
			Pathway Total:	4.1E-05	52.4%
			Total RME ILCR:	7.7E-05	100.0%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 4-54. *Summary of Potential Carcinogenic Risk Results for the Future On-site Child Resident for SWMU 35 (Remainder of SWMU)*

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	3.1E+01	1.2E-06	1.5E+00	1.9E-06	
			Pathway Total:	1.9E-06	17.6%
Dermal Contact with Surface Soil					
Arsenic	3.1E+01	2.3E-08	1.5E+00	3.5E-08	
			Pathway Total:	3.5E-08	0.3%
Inhalation of Particulates					
Arsenic	1.5E-06	2.8E-08	1.5E+01	4.2E-07	
Benzenehexachloride, delta-	4.4E-10	8.2E-12	1.8E+00	1.5E-11	
Chlordane, alpha-	6.8E-08	1.3E-09	1.3E+00	1.7E-09	
Chlordane, gamma-	6.8E-08	1.3E-09	1.3E+00	1.7E-09	
Endosulfan, alpha-	9.8E-13	NA[d]	NA	NA	
Endrin	2.0E-08	NA	NA	NA	
Heptachlor	3.4E-12	6.3E-14	4.6E+00	2.9E-13	
Heptachlor Epoxide	2.0E-10	3.6E-12	9.1E+00	3.3E-11	
			Pathway Total:	4.3E-07	4.1%
Ingestion of Leafy Vegetables					
Arsenic	8.7E-02	2.1E-06	1.5E+00	3.2E-06	
			Pathway Total:	3.2E-06	30.2%
Ingestion of Tubers and Fruits					
Arsenic	4.1E-02	3.3E-06	1.5E+00	5.0E-06	
			Pathway Total:	5.0E-06	47.8%
			Total CTE ILCR:	1.1E-05	100.0%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	3.1E+01	1.4E-05	1.5E+00	2.1E-05	
			Pathway Total:	2.1E-05	31.4%
Dermal Contact with Surface Soil					
Arsenic	3.1E+01	3.1E-07	1.5E+00	4.8E-07	
			Pathway Total:	4.8E-07	0.7%
Inhalation of Particulates					
Arsenic	1.5E-06	4.6E-08	1.5E+01	6.9E-07	
Benzenehexachloride, delta-	1.4E-09	4.1E-11	1.8E+00	7.4E-11	
Chlordane, alpha-	1.4E-07	4.3E-09	1.3E+00	5.6E-09	
Chlordane, gamma-	1.4E-07	4.3E-09	1.3E+00	5.6E-09	
Endosulfan, alpha-	1.7E-11	NA	NA	NA	
Endrin	2.5E-08	NA	NA	NA	
Heptachlor	8.8E-09	2.7E-10	4.6E+00	1.2E-09	
Heptachlor Epoxide	1.5E-06	4.4E-08	9.1E+00	4.0E-07	
			Pathway Total:	1.1E-06	1.7%
Ingestion of Leafy Vegetables					
Arsenic	8.7E-02	1.1E-05	1.5E+00	1.7E-05	
			Pathway Total:	1.7E-05	25.6%
Ingestion of Tubers and Fruits					
Arsenic	4.1E-02	1.8E-05	1.5E+00	2.7E-05	
			Pathway Total:	2.7E-05	40.5%
			Total RME ILCR:	6.6E-05	100.0%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 4-55. Summary of Potenital Carcinogenic Risk Results for the Current/Future On-site Laborer for SWMU 35 as a Whole

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] (mg/kg-day)$^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	3.1E+01	3.0E-09	1.5E+00	4.4E-09	
Benzenehexachloride, delta-	2.3E-02	2.2E-12	1.8E+00	3.9E-12	
Chlordane, alpha-	3.5E+00	3.3E-10	1.3E+00	4.3E-10	
Chlordane, gamma-	3.5E+00	3.3E-10	1.3E+00	4.3E-10	
Endosulfan, alpha-	4.2E-05	NA[d]	NA	NA	
Endrin	1.1E-01	NA	NA	NA	
Heptachlor	1.9E-04	1.8E-14	4.5E+00	8.1E-14	
Heptachlor Epoxide	1.1E-02	1.0E-12	9.1E+00	9.5E-12	
			Pathway Total:	5.3E-09	74%
Dermal Contact with Surface Soil					
Arsenic	3.1E+01	1.5E-10	1.5E+00	2.3E-10	
Benzenehexachloride, delta-	2.3E-02	1.1E-12	2.0E+00	2.1E-12	
Chlordane, alpha-	3.5E+00	1.7E-10	1.6E+00	2.7E-10	
Chlordane, gamma-	3.5E+00	1.7E-10	1.6E+00	2.7E-10	
Endosulfan, alpha-	4.2E-05	NA	NA	NA	
Endrin	1.1E-01	NA	NA	NA	
Heptachlor	1.9E-04	NA	NA	NA	
Heptachlor Epoxide	1.1E-02	NA	NA	NA	
			Pathway Total:	7.7E-10	11%
Inhalation of Particulates					
Arsenic	1.5E-06	6.9E-11	1.5E+01	1.0E-09	
Benzenehexachloride, delta-	1.1E-09	5.1E-14	1.8E+00	9.2E-14	
Chlordane, alpha-	1.7E-07	7.7E-12	1.3E+00	1.0E-11	
Chlordane, gamma-	1.7E-07	7.7E-12	1.3E+00	1.0E-11	
Endosulfan, alpha-	2.0E-12	NA	NA	NA	
Endrin	5.4E-09	NA	NA	NA	
Heptachlor	9.3E-12	4.2E-16	4.6E+00	1.9E-15	
Heptachlor Epoxide	5.4E-10	2.4E-14	9.1E+00	2.2E-13	
			Pathway Total:	1.1E-09	15%
			Total CTE ILCR:	7.1E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	3.1E+01	2.4E-06	1.5E+00	3.6E-06	
Benzenehexachloride, delta-	2.0E-02	1.5E-09	1.8E+00	2.7E-09	
Chlordane, alpha-	2.2E+00	1.7E-07	1.3E+00	2.1E-07	
Chlordane, gamma-	2.2E+00	1.7E-07	1.3E+00	2.1E-07	
Endosulfan, alpha-	2.4E-04	NA	NA	NA	
Endrin	3.7E-01	NA	NA	NA	
Heptachlor	1.3E-04	9.9E-12	4.5E+00	4.5E-11	
Heptachlor Epoxide	2.2E-02	1.7E-09	9.1E+00	1.5E-08	
			Pathway Total:	4.0E-06	75%
Dermal Contact with Surface Soil					
Arsenic	3.1E+01	2.8E-07	1.5E+00	4.2E-07	
Benzenehexachloride, delta-	2.0E-02	1.8E-09	2.0E+00	3.5E-09	
Chlordane, alpha-	2.2E+00	1.9E-07	1.6E+00	3.1E-07	
Chlordane, gamma-	2.2E+00	1.9E-07	1.6E+00	3.1E-07	
Endosulfan, alpha-	2.4E-04	NA	NA	NA	
Endrin	3.7E-01	NA	NA	NA	
Heptachlor	1.3E-04	NA	NA	NA	
Heptachlor Epoxide	2.2E-02	NA	NA	NA	
			Pathway Total:	1.1E-06	20%
Inhalation of Particulates					
Arsenic	1.5E-06	1.7E-08	1.5E+01	2.5E-07	
Benzenehexachloride, delta-	9.8E-10	1.1E-11	1.8E+00	1.9E-11	
Chlordane, alpha-	1.1E-07	1.2E-09	1.3E+00	1.5E-09	
Chlordane, gamma-	1.1E-07	1.2E-09	1.3E+00	1.5E-09	
Endosulfan, alpha-	1.2E-11	NA	NA	NA	
Endrin	1.8E-08	NA	NA	NA	
Heptachlor	6.3E-12	7.0E-14	4.6E+00	3.2E-13	
Heptachlor Epoxide	1.1E-09	1.2E-11	9.1E+00	1.1E-10	
			Pathway Total:	2.5E-07	5%
			Total RME ILCR:	5.3E-06	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 4-56. Summary of Potential Carcinogenic Risk Results for the Future Recreational Visitor for SWMU 35 as a Whole

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] (mg/kg-day)$^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	3.1E+01	3.3E-08	1.5E+00	4.9E-08	
Benzenehexachloride, delta-	8.7E-03	9.2E-12	1.8E+00	1.7E-11	
Chlordane, alpha-	1.4E+00	1.5E-09	1.3E+00	1.9E-09	
Chlordane, gamma-	1.4E+00	1.5E-09	1.3E+00	1.9E-09	
Endosulfan, alpha-	1.6E-05	NA[d]	NA	NA	
Endrin	4.2E-02	NA	NA	NA	
Heptachlor	7.1E-05	7.5E-14	4.5E+00	3.4E-13	
Heptachlor Epoxide	4.1E-03	4.3E-12	9.1E+00	4.0E-11	
			Pathway Total:	5.3E-08	83%
Dermal Contact with Surface Soil					
Arsenic	3.1E+01	2.8E-09	1.5E+00	4.3E-09	
Benzenehexachloride, delta-	8.7E-03	7.8E-12	2.0E+00	1.5E-11	
Chlordane, alpha-	1.4E+00	1.3E-09	1.6E+00	2.1E-09	
Chlordane, gamma-	1.4E+00	1.3E-09	1.6E+00	2.1E-09	
Endosulfan, alpha-	1.6E-05	NA	NA	NA	
Endrin	4.2E-02	NA	NA	NA	
Heptachlor	7.1E-05	NA	NA	NA	
Heptachlor Epoxide	4.1E-03	NA	NA	NA	
			Pathway Total:	8.4E-09	13%
Inhalation of Particulates					
Arsenic	1.5E-06	1.5E-10	1.5E+01	2.3E-09	
Benzenehexachloride, delta-	4.4E-10	4.3E-14	1.8E+00	7.8E-14	
Chlordane, alpha-	6.8E-08	6.8E-12	1.3E+00	8.8E-12	
Chlordane, gamma-	6.8E-08	6.8E-12	1.3E+00	8.8E-12	
Endosulfan, alpha-	9.8E-13	NA	NA	NA	
Endrin	2.0E-08	NA	NA	NA	
Heptachlor	3.4E-12	3.4E-16	4.6E+00	1.5E-15	
Heptachlor Epoxide	2.0E-10	1.9E-14	9.1E+00	1.8E-13	
			Pathway Total:	2.3E-09	4%
			Total CTE ILCR:	6.4E-08	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	3.1E+01	2.5E-07	1.5E+00	3.7E-07	
Benzenehexachloride, delta-	1.7E-02	1.3E-10	1.8E+00	2.4E-10	
Chlordane, alpha-	1.8E+00	1.4E-08	1.3E+00	1.9E-08	
Chlordane, gamma-	1.8E+00	1.4E-08	1.3E+00	1.9E-08	
Endosulfan, alpha-	2.0E-04	NA	NA	NA	
Endrin	3.1E-01	NA	NA	NA	
Heptachlor	1.1E-04	8.7E-13	4.5E+00	3.9E-12	
Heptachlor Epoxide	1.8E-02	1.4E-10	9.1E+00	1.3E-09	
			Pathway Total:	4.1E-07	43%
Dermal Contact with Surface Soil					
Arsenic	3.1E+01	1.4E-07	1.5E+00	2.2E-07	
Benzenehexachloride, delta-	1.7E-02	7.8E-10	2.0E+00	1.5E-09	
Chlordane, alpha-	1.8E+00	8.4E-08	1.6E+00	1.4E-07	
Chlordane, gamma-	1.8E+00	8.4E-08	1.6E+00	1.4E-07	
Endosulfan, alpha-	2.0E-04	NA	NA	NA	
Endrin	3.1E-01	NA	NA	NA	
Heptachlor	1.1E-04	NA	NA	NA	
Heptachlor Epoxide	1.8E-02	NA	NA	NA	
			Pathway Total:	4.9E-07	52%
Inhalation of Particulates					
Arsenic	1.5E-06	3.4E-09	1.5E+01	5.1E-08	
Benzenehexachloride, delta-	8.3E-10	1.8E-12	1.8E+00	3.3E-12	
Chlordane, alpha-	8.9E-08	2.0E-10	1.3E+00	2.6E-10	
Chlordane, gamma-	8.9E-08	2.0E-10	1.3E+00	2.6E-10	
Endosulfan, alpha-	9.8E-12	NA	NA	NA	
Endrin	1.5E-08	NA	NA	NA	
Heptachlor	5.4E-12	1.2E-14	4.6E+00	5.4E-14	
Heptachlor Epoxide	8.8E-10	2.0E-12	9.1E+00	1.8E-11	
			Pathway Total:	5.1E-08	5%
			Total RME ILCR:	9.5E-07	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 4-57. Summary of Potential Systemic Effects for the Current/Future On-site Laborer for SWMU 35 (Ditches West of the Stable Area)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Benzenehexachloride, delta-	4.4E-02	NA[d]	NA	NA	
Chlordane, alpha-	3.5E+00	8.3E-09	6.0E-05	1.4E-04	
Chlordane, gamma-	3.5E+00	8.3E-09	6.0E-05	1.4E-04	
Endosulfan, alpha-	9.0E-05	2.1E-13	6.0E-03	3.6E-11	
Endrin	1.1E-01	2.6E-10	3.0E-04	8.7E-07	
Heptachlor	1.9E-04	4.5E-13	5.0E-04	9.0E-10	
Heptachlor Epoxide	1.1E-02	2.6E-11	1.3E-05	2.0E-06	
			Pathway Total:	2.8E-04	0.7%
Dermal Contact with Surface Soil					
Benzenehexachloride, delta-	4.4E-02	NA	NA	NA	
Chlordane, alpha-	3.5E+00	9.2E-07	4.8E-05	1.9E-02	
Chlordane, gamma-	3.5E+00	9.2E-07	4.8E-05	1.9E-02	
Endosulfan, alpha-	9.0E-05	2.4E-11	3.0E-03	8.0E-09	
Endrin	1.1E-01	NA	NA	NA	
Heptachlor	1.9E-04	NA	NA	NA	
Heptachlor Epoxide	1.1E-02	NA	NA	NA	
			Pathway Total:	3.8E-02	99.3%
Inhalation of Particulates					
Arsenic	1.5E-06	NA	NA	NA	
Benzenehexachloride, delta-	1.1E-09	NA	NA	NA	
Chlordane, alpha-	1.7E-07	NA	NA	NA	
Chlordane, gamma-	1.7E-07	NA	NA	NA	
Endosulfan, alpha-	2.0E-12	NA	NA	NA	
Endrin	5.4E-09	NA	NA	NA	
Heptachlor	9.3E-12	NA	NA	NA	
Heptachlor Epoxide	5.4E-10	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	3.9E-02	100.0%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Benzenehexachloride, delta-	3.8E-02	NA	NA	NA	
Chlordane, alpha-	2.2E+00	4.9E-07	6.0E-05	8.2E-03	
Chlordane, gamma-	2.2E+00	4.9E-07	6.0E-05	8.2E-03	
Endosulfan, alpha-	5.5E-04	1.3E-10	6.0E-03	2.1E-08	
Endrin	3.7E-01	8.4E-08	3.0E-04	2.8E-04	
Heptachlor	1.3E-04	3.0E-11	5.0E-04	5.9E-08	
Heptachlor Epoxide	2.2E-02	5.0E-09	1.3E-05	3.9E-04	
			Pathway Total:	1.7E-02	41.73%
Dermal Contact with Surface Soil					
Benzenehexachloride, delta-	3.8E-02	NA	NA	NA	
Chlordane, alpha-	2.2E+00	5.8E-07	4.8E-05	1.2E-02	
Chlordane, gamma-	2.2E+00	5.8E-07	4.8E-05	1.2E-02	
Endosulfan, alpha-	5.5E-04	1.5E-10	3.0E-03	4.9E-08	
Endrin	3.7E-01	NA	NA	NA	
Heptachlor	1.3E-04	NA	NA	NA	
Heptachlor Epoxide	2.2E-02	NA	NA	NA	
			Pathway Total:	2.4E-02	58.3%
Inhalation of Particulates					
Arsenic	1.5E-06	NA	NA	NA	
Benzenehexachloride, delta-	9.8E-10	NA	NA	NA	
Chlordane, alpha-	1.1E-07	NA	NA	NA	
Chlordane, gamma-	1.1E-07	NA	NA	NA	
Endosulfan, alpha-	1.2E-11	NA	NA	NA	
Endrin	1.8E-08	NA	NA	NA	
Heptachlor	6.3E-12	NA	NA	NA	
Heptachlor Epoxide	1.1E-09	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	4.1E-02	100.0%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 4-58. Summary of Potential Systemic Effects for the Future On-site Adult Resident for SWMU 35 (Ditches West of the Stable Area)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Benzenehexachloride, delta-	1.6E-02	NA[d]	NA	NA	
Chlordane, alpha-	1.4E+00	1.2E-07	6.0E-05	1.9E-03	
Chlordane, gamma-	1.4E+00	1.2E-07	6.0E-05	1.9E-03	
Endosulfan, alpha-	3.5E-04	2.9E-11	6.0E-03	4.8E-09	
Endrin	4.2E-02	3.5E-09	3.0E-04	1.2E-05	
Heptachlor	7.1E-04	5.8E-11	5.0E-04	1.2E-07	
Heptachlor Epoxide	4.1E-03	3.4E-10	1.3E-05	2.6E-05	
			Pathway Total:	3.9E-03	0.3%
Dermal Contact with Surface Soil					
Benzenehexachloride, delta-	1.6E-02	NA	NA	NA	
Chlordane, alpha-	1.4E+00	5.8E-08	4.8E-05	1.2E-03	
Chlordane, gamma-	1.4E+00	5.8E-08	4.8E-05	1.2E-03	
Endosulfan, alpha-	3.5E-04	1.4E-11	3.0E-03	4.8E-09	
Endrin	4.2E-02	NA	NA	NA	
Heptachlor	7.1E-04	NA	NA	NA	
Heptachlor Epoxide	4.1E-03	NA	NA	NA	
			Pathway Total:	2.4E-03	0.2%
Inhalation of Particulates					
Arsenic	1.5E-06	NA	NA	NA	
Benzenehexachloride, delta-	4.4E-10	NA	NA	NA	
Chlordane, alpha-	6.8E-08	NA	NA	NA	
Chlordane, gamma-	6.8E-08	NA	NA	NA	
Endosulfan, alpha-	9.8E-13	NA	NA	NA	
Endrin	2.0E-08	NA	NA	NA	
Heptachlor	3.4E-12	NA	NA	NA	
Heptachlor Epoxide	2.0E-10	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Benzenehexachloride, delta-	7.0E-04	NA	NA	NA	
Chlordane, alpha-	3.9E-03	5.5E-07	6.0E-05	9.1E-03	
Chlordane, gamma-	2.7E-05	3.8E-09	6.0E-05	6.3E-05	
Endosulfan, alpha-	2.4E-06	3.3E-10	6.0E-03	5.5E-08	
Endrin	2.6E-04	3.6E-08	3.0E-04	1.2E-04	
Heptachlor	3.5E-07	5.0E-11	5.0E-04	9.9E-08	
Heptachlor Epoxide	2.3E-05	3.2E-09	1.3E-05	2.5E-04	
			Pathway Total:	9.6E-03	0.8%
Ingestion of Tubers and Fruits					
Benzenehexachloride, delta-	2.4E-02	NA	NA	NA	
Chlordane, alpha-	1.4E-01	6.4E-05	6.0E-05	1.1E+00	
Chlordane, gamma-	9.5E-04	4.5E-07	6.0E-05	7.5E-03	
Endosulfan, alpha-	8.3E-05	3.9E-08	6.0E-03	6.5E-06	
Endrin	9.0E-03	4.2E-06	3.0E-04	1.4E-02	
Heptachlor	1.2E-05	5.8E-09	5.0E-04	1.2E-05	
Heptachlor Epoxide	8.1E-04	3.8E-07	1.3E-05	2.9E-02	
			Pathway Total:	1.1E+00	98.6%
			Total CTE HI:	1.1E+00	100.0%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Benzenehexachloride, delta-	3.2E-02	NA	NA	NA	
Chlordane, alpha-	1.8E+00	9.4E-07	6.0E-05	1.6E-02	
Chlordane, gamma-	1.8E+00	9.4E-07	6.0E-05	1.6E-02	
Endosulfan, alpha-	4.6E-04	2.4E-10	6.0E-03	4.0E-08	
Endrin	3.1E-01	1.6E-07	3.0E-04	5.4E-04	
Heptachlor	1.1E-04	5.7E-11	5.0E-04	1.1E-07	
Heptachlor Epoxide	1.8E-02	9.3E-09	1.3E-05	7.2E-04	
			Pathway Total:	3.3E-02	0.6%

Table 4-58. Summary of Potential Systemic Effects for the Future On-site Adult Resident for SWMU 35 (Ditches West of the Stable Area) (continued)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Dermal Contact with Surface Soil					
Benzenehexachloride, delta-	3.2E-02	NA	NA	NA	
Chlordane, alpha-	1.8E+00	1.1E-06	4.8E-05	2.3E-02	
Chlordane, gamma-	1.8E+00	1.1E-06	4.8E-05	2.3E-02	
Endosulfan, alpha-	4.6E-04	2.8E-10	3.0E-03	9.3E-08	
Endrin	3.1E-01	NA	NA	NA	
Heptachlor	1.1E-04	NA	NA	NA	
Heptachlor Epoxide	1.8E-02	NA	NA	NA	
			Pathway Total:	4.6E-02	0.8%
Inhalation of Particulates					
Arsenic	1.5E-06	NA	NA	NA	
Benzenehexachloride, delta-	8.3E-10	NA	NA	NA	
Chlordane, alpha-	8.9E-08	NA	NA	NA	
Chlordane, gamma-	8.9E-08	NA	NA	NA	
Endosulfan, alpha-	9.8E-12	NA	NA	NA	
Endrin	1.5E-08	NA	NA	NA	
Heptachlor	5.4E-12	NA	NA	NA	
Heptachlor Epoxide	8.8E-10	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Benzenehexachloride, delta-	1.4E-03	NA	NA	NA	
Chlordane, alpha-	5.1E-03	2.5E-06	6.0E-05	4.2E-02	
Chlordane, gamma-	3.5E-05	1.7E-08	6.0E-05	2.9E-04	
Endosulfan, alpha-	3.1E-05	1.5E-08	6.0E-03	2.5E-06	
Endrin	1.9E-03	9.4E-07	3.0E-04	3.1E-03	
Heptachlor	5.3E-07	2.6E-10	5.0E-04	5.2E-07	
Heptachlor Epoxide	1.0E-04	5.0E-08	1.3E-05	3.9E-03	
			Pathway Total:	4.9E-02	0.8%
Ingestion of Tubers and Fruits					
Benzenehexachloride, delta-	4.7E-02	NA	NA	NA	
Chlordane, alpha-	1.8E-01	2.9E-04	6.0E-05	4.9E+00	
Chlordane, gamma-	1.2E-03	2.0E-06	6.0E-05	3.4E-02	
Endosulfan, alpha-	1.1E-03	1.8E-06	6.0E-03	2.9E-04	
Endrin	6.7E-02	1.1E-04	3.0E-04	3.7E-01	
Heptachlor	1.9E-05	3.1E-08	5.0E-04	6.1E-05	
Heptachlor Epoxide	3.6E-03	6.0E-06	1.3E-05	4.6E-01	
			Pathway Total:	5.8E+00	97.8%
			Total RME HI:	5.9E+00	100.0%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 4-59. Summary of Potential Systemic Effects for the Future On-site Child Resident for SWMU 35 (Ditches West of the Stable Area)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Benzenehexachloride, delta-	1.6E-02	NA[d]	NA	NA	
Chlordane, alpha-	1.4E+00	5.2E-07	6.0E-05	8.7E-03	
Chlordane, gamma-	1.4E+00	5.2E-07	6.0E-05	8.7E-03	
Endosulfan, alpha-	3.5E-05	1.3E-11	6.0E-03	2.2E-09	
Endrin	4.2E-02	1.6E-08	3.0E-04	5.2E-05	
Heptachlor	7.1E-05	2.6E-11	5.0E-04	5.3E-08	
Heptachlor Epoxide	4.1E-03	1.5E-09	1.3E-05	1.2E-04	
			Pathway Total:	1.8E-02	0.9%
Dermal Contact with Surface Soil					
Benzenehexachloride, delta-	1.6E-02	NA	NA	NA	
Chlordane, alpha-	1.4E+00	9.7E-08	4.8E-05	2.0E-03	
Chlordane, gamma-	1.4E+00	9.7E-08	4.8E-05	2.0E-03	
Endosulfan, alpha-	3.5E-05	2.4E-12	4.8E-05	5.0E-08	
Endrin	4.2E-02	NA	NA	NA	
Heptachlor	7.1E-05	NA	NA	NA	
Heptachlor Epoxide	4.1E-03	NA	NA	NA	
			Pathway Total:	4.0E-03	0.2%
Inhalation of Particulates					
Arsenic	1.5E-06	NA	NA	NA	
Benzenehexachloride, delta-	4.4E-10	NA	NA	NA	
Chlordane, alpha-	6.8E-08	NA	NA	NA	
Chlordane, gamma-	6.8E-08	NA	NA	NA	
Endosulfan, alpha-	9.8E-13	NA	NA	NA	
Endrin	2.0E-08	NA	NA	NA	
Heptachlor	3.4E-12	NA	NA	NA	
Heptachlor Epoxide	2.0E-10	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Benzenehexachloride, delta-	7.0E-04	NA	NA	NA	
Chlordane, alpha-	3.9E-03	8.9E-07	6.0E-05	1.5E-02	
Chlordane, gamma-	2.7E-05	6.2E-09	6.0E-05	1.0E-04	
Endosulfan, alpha-	2.4E-06	5.4E-10	6.0E-03	9.0E-08	
Endrin	2.6E-04	5.8E-08	3.0E-04	1.9E-04	
Heptachlor	3.5E-07	8.0E-11	5.0E-04	1.6E-07	
Heptachlor Epoxide	2.3E-05	5.3E-09	1.3E-05	4.1E-04	
			Pathway Total:	1.5E-02	0.8%
Ingestion of Tubers and Fruits					
Benzenehexachloride, delta-	2.4E-02	NA	NA	NA	
Chlordane, alpha-	1.4E-01	1.0E-04	6.0E-05	1.7E+00	
Chlordane, gamma-	9.5E-04	7.3E-07	6.0E-05	1.2E-02	
Endosulfan, alpha-	8.3E-05	6.3E-08	6.0E-03	1.1E-05	
Endrin	9.0E-03	6.8E-06	3.0E-04	2.3E-02	
Heptachlor	1.2E-05	9.5E-09	5.0E-04	1.9E-05	
Heptachlor Epoxide	8.1E-04	6.2E-07	1.3E-05	4.8E-02	
			Pathway Total:	1.8E+00	98.0%
			Total CTE HI:	1.9E+00	100.0%

Table 4-59. Summary of Potential Systemic Effects for the Future On-site Child Resident for SWMU 35 (Ditches West of the Stable Area) (continued)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Benzenehexachloride, delta-	5.3E-02	NA	NA	NA	
Chlordane, alpha-	2.9E+00	5.4E-06	6.0E-05	9.0E-02	
Chlordane, gamma-	2.9E+00	5.4E-06	6.0E-05	9.0E-02	
Endosulfan, alpha-	7.6E-04	1.4E-09	6.0E-03	2.3E-07	
Endrin	5.2E-01	9.6E-07	3.0E-04	3.2E-03	
Heptachlor	1.8E-04	3.3E-10	5.0E-04	6.7E-07	
Heptachlor Epoxide	3.0E-02	5.6E-08	1.3E-05	4.3E-03	
			Pathway Total:	1.9E-01	1.8%
Dermal Contact with Surface Soil					
Benzenehexachloride, delta-	5.3E-02	NA	NA	NA	
Chlordane, alpha-	2.9E+00	1.2E-06	4.8E-05	2.6E-02	
Chlordane, gamma-	2.9E+00	1.2E-06	4.8E-05	2.6E-02	
Endosulfan, alpha-	7.6E-04	3.2E-10	4.8E-05	6.7E-06	
Endrin	5.2E-01	NA	NA	NA	
Heptachlor	1.8E-04	NA	NA	NA	
Heptachlor Epoxide	3.0E-02	NA	NA	NA	
			Pathway Total:	5.2E-02	0.5%
Inhalation of Particulates					
Arsenic	1.5E-06	NA	NA	NA	
Benzenehexachloride, delta-	1.4E-09	NA	NA	NA	
Chlordane, alpha-	1.4E-07	NA	NA	NA	
Chlordane, gamma-	1.4E-07	NA	NA	NA	
Endosulfan, alpha-	1.7E-11	NA	NA	NA	
Endrin	2.5E-08	NA	NA	NA	
Heptachlor	8.8E-09	NA	NA	NA	
Heptachlor Epoxide	1.5E-06	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Benzenehexachloride, delta-	2.3E-03	NA	NA	NA	
Chlordane, alpha-	8.2E-03	4.4E-06	6.0E-05	7.3E-02	
Chlordane, gamma-	5.7E-05	3.1E-08	6.0E-05	5.1E-04	
Endosulfan, alpha-	5.1E-05	2.7E-08	6.0E-03	4.6E-06	
Endrin	3.2E-03	1.7E-06	3.0E-04	5.7E-03	
Heptachlor	8.8E-07	4.7E-10	5.0E-04	9.5E-07	
Heptachlor Epoxide	1.7E-04	9.2E-08	1.3E-05	7.1E-03	
			Pathway Total:	8.7E-02	0.8%
Ingestion of Tubers and Fruits					
Benzenehexachloride, delta-	7.9E-02	NA	NA	NA	
Chlordane, alpha-	2.9E-01	5.2E-04	6.0E-05	8.7E+00	
Chlordane, gamma-	2.0E-03	3.6E-06	6.0E-05	6.0E-02	
Endosulfan, alpha-	1.8E-03	3.2E-06	6.0E-03	5.4E-04	
Endrin	1.1E-01	2.0E-04	3.0E-04	6.6E-01	
Heptachlor	3.1E-05	5.6E-08	5.0E-04	1.1E-04	
Heptachlor Epoxide	6.0E-03	1.1E-05	1.3E-05	8.3E-01	
			Pathway Total:	1.0E+01	96.9%
			Total RME HI:	1.1E+01	100.0%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 4-60. Summary of Potential Systemic Effects for the Current/Future On-site Laborer for SWMU 35 (Remainder of SWMU)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	3.1E+01	7.4E-08	3.0E-04	2.5E-04	
			Pathway Total:	2.5E-04	95%
Dermal Contact with Surface Soil					
Arsenic	3.1E+01	3.7E-09	2.9E-04	1.3E-05	
			Pathway Total:	1.3E-05	5%
Inhalation of Particulates					
Arsenic	1.5E-06	NA(d)	NA	NA	
Benzenehexachloride, delta-	1.1E-09	NA	NA	NA	
Chlordane, alpha-	1.7E-07	NA	NA	NA	
Chlordane, gamma-	1.7E-07	NA	NA	NA	
Endosulfan, alpha-	2.0E-12	NA	NA	NA	
Endrin	5.4E-09	NA	NA	NA	
Heptachlor	9.3E-12	NA	NA	NA	
Heptachlor Epoxide	5.4E-10	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	2.6E-04	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	3.1E+01	7.1E-06	3.0E-04	2.4E-02	
			Pathway Total:	2.4E-02	89%
Dermal Contact with Surface Soil					
Arsenic	3.1E+01	8.2E-07	2.9E-04	2.8E-03	
			Pathway Total:	2.8E-03	11%
Inhalation of Particulates					
Arsenic	1.5E-06	NA	NA	NA	
Benzenehexachloride, delta-	9.8E-10	NA	NA	NA	
Chlordane, alpha-	1.1E-07	NA	NA	NA	
Chlordane, gamma-	1.1E-07	NA	NA	NA	
Endosulfan, alpha-	1.2E-11	NA	NA	NA	
Endrin	1.8E-08	NA	NA	NA	
Heptachlor	6.3E-12	NA	NA	NA	
Heptachlor Epoxide	1.1E-09	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	2.6E-02	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 4-61. Summary of Potential Systemic Effects for the Future On-site Adult Resident for SWMU 35 (Remainder of SWMU)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	3.1E+01	2.6E-06	3.0E-04	8.5E-03	
			Pathway Total:	8.5E-03	7.5%
Dermal Contact with Surface Soil					
Arsenic	3.1E+01	1.3E-07	2.9E-04	4.3E-04	
			Pathway Total:	4.3E-04	0.4%
Inhalation of Particulates					
Arsenic	1.5E-06	NA[d]	NA	NA	
Benzenehexachloride, delta-	4.4E-10	NA	NA	NA	
Chlordane, alpha-	6.8E-08	NA	NA	NA	
Chlordane, gamma-	6.8E-08	NA	NA	NA	
Endosulfan, alpha-	9.8E-13	NA	NA	NA	
Endrin	2.0E-08	NA	NA	NA	
Heptachlor	3.4E-12	NA	NA	NA	
Heptachlor Epoxide	2.0E-10	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Arsenic	8.7E-02	1.2E-05	3.0E-04	4.1E-02	
			Pathway Total:	4.1E-02	35.7%
Ingestion of Tubers and Fruits					
Arsenic	4.1E-02	1.9E-05	3.0E-04	6.4E-02	
			Pathway Total:	6.4E-02	56.5%
			Total CTE HI:	1.1E-01	100.0%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	3.1E+01	1.6E-05	3.0E-04	5.4E-02	
			Pathway Total:	5.4E-02	12.6%
Dermal Contact with Surface Soil					
Arsenic	3.1E+01	1.9E-06	2.9E-04	6.4E-03	
			Pathway Total:	6.4E-03	1.5%
Inhalation of Particulates					
Arsenic	1.5E-06	NA	NA	NA	
Benzenehexachloride, delta-	8.3E-10	NA	NA	NA	
Chlordane, alpha-	8.9E-08	NA	NA	NA	
Chlordane, gamma-	8.9E-08	NA	NA	NA	
Endosulfan, alpha-	9.8E-12	NA	NA	NA	
Endrin	1.5E-08	NA	NA	NA	
Heptachlor	5.4E-12	NA	NA	NA	
Heptachlor Epoxide	8.8E-10	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Arsenic	8.7E-02	4.3E-05	3.0E-04	1.4E-01	
			Pathway Total:	1.4E-01	33.2%
Ingestion of Tubers and Fruits					
Arsenic	4.1E-02	6.8E-05	3.0E-04	2.3E-01	
			Pathway Total:	2.3E-01	52.8%
			Total RME HI:	4.3E-01	100.0%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 4-62. Summary of Potential Systemic Effects for the Future On-site Child Resident for SWMU 35 (Remainder of SWMU)

Chemical	Exposure Point Concentration (mg/kg)[(a)]	Daily Noncarcinogenic Intake[(b)] (mg/kg-day)	Chronic RfD[(c)] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	3.1E+01	1.2E-05	3.0E-04	3.9E-02	
			Pathway Total:	3.9E-02	18%
Dermal Contact with Surface Soil					
Arsenic	3.1E+01	2.2E-07	2.9E-04	7.3E-04	
			Pathway Total:	7.3E-04	0%
Inhalation of Particulates					
Arsenic	1.5E-06	NA[(d)]	NA	NA	
Benzenehexachloride, delta-	4.4E-10	NA	NA	NA	
Chlordane, alpha-	6.8E-08	NA	NA	NA	
Chlordane, gamma-	6.8E-08	NA	NA	NA	
Endosulfan, alpha-	9.8E-13	NA	NA	NA	
Endrin	2.0E-08	NA	NA	NA	
Heptachlor	3.4E-12	NA	NA	NA	
Heptachlor Epoxide	2.0E-10	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Arsenic	8.7E-02	2.0E-05	3.0E-04	6.6E-02	
			Pathway Total:	6.6E-02	31%
Ingestion of Tubers and Fruits					
Arsenic	4.1E-02	3.1E-05	3.0E-04	1.0E-01	
			Pathway Total:	1.0E-01	50%
			Total CTE HI:	2.1E-01	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	3.1E+01	5.8E-05	3.0E-04	1.9E-01	
			Pathway Total:	1.9E-01	32%
Dermal Contact with Surface Soil					
Arsenic	3.1E+01	1.3E-06	2.9E-04	4.5E-03	
			Pathway Total:	4.5E-03	1%
Inhalation of Particulates					
Arsenic	1.5E-06	NA	NA	NA	
Benzenehexachloride, delta-	1.4E-09	NA	NA	NA	
Chlordane, alpha-	1.4E-07	NA	NA	NA	
Chlordane, gamma-	1.4E-07	NA	NA	NA	
Endosulfan, alpha-	1.7E-11	NA	NA	NA	
Endrin	2.5E-08	NA	NA	NA	
Heptachlor	8.8E-09	NA	NA	NA	
Heptachlor Epoxide	1.5E-06	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Arsenic	8.7E-02	4.7E-05	3.0E-04	1.6E-01	
			Pathway Total:	1.6E-01	26%
Ingestion of Tubers and Fruits					
Arsenic	4.1E-02	7.4E-05	3.0E-04	2.5E-01	
			Pathway Total:	2.5E-01	41%
			Total RME HI:	6.0E-01	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 4-63. Summary of Potential Systemic Effects for the Current/Future On-site Laborer for SWMU 35 as a Whole

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	3.1E+01	7.4E-08	3.0E-04	2.5E-04	
Benzenehexachloride, delta-	2.3E-02	NA[d]	NA	NA	
Chlordane, alpha-	3.5E+00	8.3E-09	6.0E-05	1.4E-04	
Chlordane, gamma-	3.5E+00	8.3E-09	6.0E-05	1.4E-04	
Endosulfan, alpha-	4.2E-05	1.0E-13	6.0E-03	1.7E-11	
Endrin	1.1E-01	2.6E-10	3.0E-04	8.8E-07	
Heptachlor	1.9E-04	4.5E-13	5.0E-04	9.0E-10	
Heptachlor Epoxide	1.1E-02	2.6E-11	1.3E-05	2.0E-06	
			Pathway Total:	5.2E-04	74%
Dermal Contact with Surface Soil					
Arsenic	3.1E+01	3.7E-09	2.9E-04	1.3E-05	
Benzenehexachloride, delta-	2.3E-02	NA	NA	NA	
Chlordane, alpha-	3.5E+00	4.1E-09	4.8E-05	8.6E-05	
Chlordane, gamma-	3.5E+00	4.1E-09	4.8E-05	8.6E-05	
Endosulfan, alpha-	4.2E-05	5.0E-14	3.0E-03	1.7E-11	
Endrin	1.1E-01	NA	NA	NA	
Heptachlor	1.9E-04	NA	NA	NA	
Heptachlor Epoxide	1.1E-02	NA	NA	NA	
			Pathway Total:	1.8E-04	26%
Inhalation of Particulates					
Arsenic	1.5E-06	NA	NA	NA	
Benzenehexachloride, delta-	1.1E-09	NA	NA	NA	
Chlordane, alpha-	1.7E-07	NA	NA	NA	
Chlordane, gamma-	1.7E-07	NA	NA	NA	
Endosulfan, alpha-	2.0E-12	NA	NA	NA	
Endrin	5.4E-09	NA	NA	NA	
Heptachlor	9.3E-12	NA	NA	NA	
Heptachlor Epoxide	5.4E-10	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	7.1E-04	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	3.1E+01	7.1E-06	3.0E-04	2.4E-02	
Benzenehexachloride, delta-	2.0E-02	NA	NA	NA	
Chlordane, alpha-	2.2E+00	4.9E-07	6.0E-05	8.2E-03	
Chlordane, gamma-	2.2E+00	4.9E-07	6.0E-05	8.2E-03	
Endosulfan, alpha-	2.4E-04	5.5E-11	6.0E-03	9.1E-09	
Endrin	3.7E-01	8.4E-08	3.0E-04	2.8E-04	
Heptachlor	1.3E-04	3.0E-11	5.0E-04	5.9E-08	
Heptachlor Epoxide	2.2E-02	5.0E-09	1.3E-05	3.9E-04	
			Pathway Total:	4.1E-02	60%
Dermal Contact with Surface Soil					
Arsenic	3.1E+01	8.2E-07	2.9E-04	2.8E-03	
Benzenehexachloride, delta-	2.0E-02	NA	NA	NA	
Chlordane, alpha-	2.2E+00	5.8E-07	4.8E-05	1.2E-02	
Chlordane, gamma-	2.2E+00	5.8E-07	4.8E-05	1.2E-02	
Endosulfan, alpha-	2.4E-04	6.4E-11	3.0E-03	2.1E-08	
Endrin	3.7E-01	NA	NA	NA	
Heptachlor	1.3E-04	NA	NA	NA	
Heptachlor Epoxide	2.2E-02	NA	NA	NA	
			Pathway Total:	2.7E-02	40%
Inhalation of Particulates					
Arsenic	1.5E-06	NA	NA	NA	
Benzenehexachloride, delta-	9.8E-10	NA	NA	NA	
Chlordane, alpha-	1.1E-07	NA	NA	NA	
Chlordane, gamma-	1.1E-07	NA	NA	NA	
Endosulfan, alpha-	1.2E-11	NA	NA	NA	
Endrin	1.8E-08	NA	NA	NA	
Heptachlor	6.3E-12	NA	NA	NA	
Heptachlor Epoxide	1.1E-09	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	6.8E-02	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 4-64. Summary of Potential Systemic Effects for the Future Recreational Visitor for SWMU 35 as a Whole

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	3.1E+01	3.1E-07	3.0E-04	1.0E-03	
Benzenehexachloride, delta-	8.7E-03	NA(d)		NA	
Chlordane, alpha-	1.4E+00	1.4E-08	6.0E-05	2.3E-04	
Chlordane, gamma-	1.4E+00	1.4E-08	6.0E-05	2.3E-04	
Endosulfan, alpha-	1.6E-05	1.6E-13	6.0E-03	2.6E-11	
Endrin	4.2E-02	4.2E-10	3.0E-04	1.4E-06	
Heptachlor	7.1E-05	7.0E-13	5.0E-04	1.4E-09	
Heptachlor Epoxide	4.1E-03	4.1E-11	1.3E-05	3.1E-06	
			Pathway Total:	1.5E-03	72%
Dermal Contact with Surface Soil					
Arsenic	3.1E+01	2.6E-08	2.9E-04	9.1E-05	
Benzenehexachloride, delta-	8.7E-03	NA	NA	NA	
Chlordane, alpha-	1.4E+00	1.2E-08	4.8E-05	2.5E-04	
Chlordane, gamma-	1.4E+00	1.2E-08	4.8E-05	2.5E-04	
Endosulfan, alpha-	1.6E-05	1.4E-13	3.0E-03	4.5E-11	
Endrin	4.2E-02	NA	NA	NA	
Heptachlor	7.1E-05	NA	NA	NA	
Heptachlor Epoxide	4.1E-03	NA	NA	NA	
			Pathway Total:	5.8E-04	28%
Inhalation of Particulates					
Arsenic	1.5E-06	NA	NA	NA	
Benzenehexachloride, delta-	4.4E-10	NA	NA	NA	
Chlordane, alpha-	6.8E-08	NA	NA	NA	
Chlordane, gamma-	6.8E-08	NA	NA	NA	
Endosulfan, alpha-	9.8E-13	NA	NA	NA	
Endrin	2.0E-08	NA	NA	NA	
Heptachlor	3.4E-12	NA	NA	NA	
Heptachlor Epoxide	2.0E-10	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	2.1E-03	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	3.1E+01	6.2E-07	3.0E-04	2.1E-03	
Benzenehexachloride, delta-	1.7E-02	NA	NA	NA	
Chlordane, alpha-	1.8E+00	3.6E-08	6.0E-05	6.0E-04	
Chlordane, gamma-	1.8E+00	3.6E-08	6.0E-05	6.0E-04	
Endosulfan, alpha-	2.0E-04	4.0E-12	6.0E-03	6.6E-10	
Endrin	3.1E-01	6.1E-09	3.0E-04	2.0E-05	
Heptachlor	1.1E-04	2.2E-12	5.0E-04	4.4E-09	
Heptachlor Epoxide	1.8E-02	3.6E-10	1.3E-05	2.7E-05	
			Pathway Total:	3.3E-03	25%
Dermal Contact with Surface Soil					
Arsenic	3.1E+01	3.6E-07	2.9E-04	1.2E-03	
Benzenehexachloride, delta-	1.7E-02	NA	NA	NA	
Chlordane, alpha-	1.8E+00	2.1E-07	4.8E-05	4.4E-03	
Chlordane, gamma-	1.8E+00	2.1E-07	4.8E-05	4.4E-03	
Endosulfan, alpha-	2.0E-04	2.3E-11	3.0E-03	7.7E-09	
Endrin	3.1E-01	NA	NA	NA	
Heptachlor	1.1E-04	NA	NA	NA	
Heptachlor Epoxide	1.8E-02	NA	NA	NA	
			Pathway Total:	1.0E-02	75%
Inhalation of Particulates					
Arsenic	1.5E-06	NA	NA	NA	
Benzenehexachloride, delta-	8.3E-10	NA	NA	NA	
Chlordane, alpha-	8.9E-08	NA	NA	NA	
Chlordane, gamma-	8.9E-08	NA	NA	NA	
Endosulfan, alpha-	9.8E-12	NA	NA	NA	
Endrin	1.5E-08	NA	NA	NA	
Heptachlor	5.4E-12	NA	NA	NA	
Heptachlor Epoxide	8.8E-10	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	1.3E-02	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Total ILCRs for the major contributing pathway—dermal contact with surface soil by laborers at the Ditches West of the Stable Area—are 6.3E-07 and 5.4E-10 for the RME and CTE scenarios, respectively. Incidental ingestion of surface soil and inhalation of particulates by laborers does not present an individual risk above the lower bound of the target risk range. The estimated ILCRs for these pathways range from 4.5E-07 to 8.8E-10. The primary contributors to these estimated risks are alpha- and gamma-chlordane.

Future On-Site Adult Resident. The cumulative ILCR for the future on-site adult resident is 2.4E-04 and 1.2E-05 under the RME and CTE scenarios, respectively. As summarized in Table 4-50, the driving pathway is ingestion of produce (leafy vegetables, tubers, and fruits), which contributes greater than 98 percent of the estimated risk.

Ingestion of produce, such as homegrown vegetables, by adults results in an estimated ILCR of 2.3E-04 and 1.2E-05 using RME and CTE parameters, respectively. Ingestion of surface soil by adults during yard work, gardening, etc., results in an estimated ILCR of 1.0E-06 using RME conditions and 3.3E-08 using CTE conditions. For the dermal contact with surface soil pathway, the ILCRs range from 1.5E-06 to 2.0E-08 for the RME and CTE scenarios. The ILCR for the remaining pathway evaluated (inhalation of particulates) is below the target risk range for both the RME and CTE scenarios, and ranges from 4.4E-07 to 8.4E-08. The primary contributor to the RME scenario risk estimate is alpha-chlordane. For the CTE scenario, alpha-chlordane and delta-benzenehexachloride are the primary contributors to the risk estimate.

Future On-Site Child Resident. The cumulative ILCR for the future on-site child resident is 2.5E-04 and 2.0E-05 under the RME and CTE scenarios, respectively. As summarized in Table 4-51, the driving pathway is ingestion of produce (leafy vegetables, tubers, and fruits) which contributes greater than 97 percent of the estimated risk.

Ingestion of produce, such as homegrown vegetables by children results in an estimated ILCR of 2.5E-04 and 1.9E-05 using RME and CTE conditions, respectively. Ingestion of surface soil by children during yard work, playing, etc., results in an estimated ILCR of 3.5E-06 using RME conditions and 1.5E-07 using CTE conditions. The ILCR for inhalation of particulates ranges from 1.1E-06 to 4.3E-07. The ILCR for the remaining pathway evaluated—dermal contact with surface soil—is below the target risk range for both the RME and CTE scenarios, and ranges from 9.8E-07 to 3.4E-08. The primary contributors to the risk estimate for the RME and CTE scenarios are alpha- and gamma-chlordane.

Remainder of SWMU

Current/Future On-Site Laborers. The cumulative ILCR for all pathways is 4.2E-06 and 5.7E-09 for the RME and CTE scenarios, respectively. As summarized in Table 4-52, the driving pathway is ingestion of surface soil, which contributes 84 percent of the total ILCR.

For the ingestion of surface soil scenario, the toal ILCRs are 3.6E-06 and 4.4E-09 for the RME and CTE scenarios, respectively. Dermal contact with surface soil and inhalation of

particulates by laborers does not present an individual risk above the lower bound of the target risk range. The estimated ILCRs for these pathways range from 4.2E-07 to 2.3E-10. The primary contributor to these estimates of risk is arsenic.

Future On-Site Adult Resident. The cumulative ILCR for the future on-site adult resident is 7.7E-05 and 5.6E-06 under the RME and CTE scenarios, respectively. As summarized in Table 4-53, the driving pathway is ingestion of produce (leafy vegetables, tubers, and fruits), which contributes greater than 85 percent of the estimated risk.

Ingestion of produce, such as homegrown vegetables, by adults results in an estimated ILCR of 6.7E-05 and 5.1E-06 using RME and CTE parameters, respectively. Ingestion of surface soil by adults during yard work, gardening, etc., results in an estimated ILCR of 9.7E-06 using RME conditions and 4.1E-07 using CTE conditions. For the dermal contact with surface soil pathway, the ILCRs range from 1.2E-06 to 2.1E-08 for the RME and CTE scenarios. The ILCR for the remaining pathway evaluated (inhalation of particulates) is below the target risk range for both the RME and CTE scenarios, and ranges from 4.4E-07 to 8.4E-08. The main contributor to these risk estimates is arsenic.

Future On-Site Child Resident. The cumulative ILCR for the future on-site child resident is 6.6E-05 and 1.1E-05 under the RME and CTE scenarios, respectively. As summarized in Table 4-54, the driving pathway is ingestion of produce (leafy vegetables, tubers, and fruits), which contributes greater than 66 percent of the estimated risk.

Ingestion of produce, such as homegrown vegetables by children, results in an estimated ILCR of 4.4E-05 and 8.2E-06 using RME and CTE conditions, respectively. Ingestion of surface soil by children during yard work, playing, etc., results in an estimated ILCR of 2.1E-05 using RME conditions and 1.9E-06 using CTE conditions. The ILCR for the inhalation of particulates pathway ranges from 1.1E-06 to 4.3E-07. The ILCR for the remaining pathway evaluated—dermal contact with surface soil—is below the target risk range for both the RME and CTE scenarios, and ranges from 4.8E-07 to 3.5E-08. The main contributor to these estimates of risk is arsenic.

SWMU 35 as a Whole

Current/Future On-Site Laborers. The cumulative ILCR for all pathways is 5.3E-06 and 7.1E-09 for the RME and CTE scenarios, respectively. As summarized in Table 4-55, the driving pathway is ingestion of surface soil, which contributes 75 percent of the total ILCR.

For the ingestion of surface soil scenario, the toal ILCRs are 4.0E-06 and 5.3E-09 for the RME and CTE scenarios, respectively. The total ILCR for the dermal contact with surface soil pathway ranges from 1.1E-06 to 7.7E-10 for the RME and CTE scenarios, respectively. The remaining pathway evaluated, inhalation of particulates by laborers, does not present an individual risk above the lower bound of the target risk range. Arsenic is the primary contributor to these estimates of risk.

Future Recreational Visitor. The cumulative ILCR for the future recreation visitor is 9.5E-07 and 6.4E-08 under the RME and CTE scenarios, respectively. As summarized in Table 4-56, the driving pathway for the RME scenario is dermal contact with surface soil (52 percent) and ingestion of soil (83 percent) for the CTE scenario. Arsenic is the primary contributor to these estimates of risk.

4.3.4.6.2 ***Characterization of Potential Systemic Effects***. The general process used to select the COPCs associated with SWMU 35 is described in Section 3.1.1. COPC selection for SWMU 35 is described in Section 4.3.4.2. For current and future land use scenarios, arsenic, delta-benzehexachloride, alpha-chlordane, gamma-chlordane, alpha-endosulfan, endrin, heptachlor, and heptachlor epoxide were identified as the COPCs. Systemic effects were estimated for all COPCs associated with SWMU 35. The inhalation pathway was not evaluated because no inhalation reference doses for the COPC were not available at the time of this report. Tables 4-44 through 4-48 list the COPC and associated media.

Ditches West of the Stable Area

Current/Future On-Site Laborer. As summarized in Table 4-57, the summed HI for all pathways does not exceed unity (one). The total HIs for all pathways range from 4.1E-02 and 3.9E-02 for the RME and CTE scenarios, respectively. The driving pathway is dermal contact with surface soil which contributes greater than 58 percent of the total HI.

Future On-Site Adult Resident. As summarized in Table 4-58, the summed HI for all pathways ranges from 5.9E+00 to 1.1E+00 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of produce, which contributes greater than 98 percent of the total HI.

The total HI for ingestion of produce by adult residents is 5.8E+00 and 1.1E+00 for the RME and CTE scenarios, respectively. The inhalation pathway was not evaluated because inhalation reference doses for the COPCs were not available at the time of this report. The HI for the remaining pathways evaluated are well below unity (one) and range from 4.6E-02 to 2.4E-03. Alpha-chlordane is the primary contributor to these estimates of risk.

Future On-Site Child Resident. As summarized in Table 4-59, the summed HIs for all pathways range from 1.1E+01 to 1.9E+00 for the RME and CTE scenarios, respectively. The driving pathway for the CTE is ingestion of produce, leafy vegetables, tubers, and fruits, which contributes 98 percent of the total HI.

The total HI for ingestion of produce by child residents is 1.0E+01 and 1.8E+00 for the RME and CTE scenarios, respectively. The inhalation pathway was not evaluated because inhalation reference doses for the COPCs were not available at the time of this report. The HIs for the remaining pathways evaluated are below unity (one) and range from 1.9E-01 to 4.0E-03. Alpha-chlordane is the primary contributor to these estimates of risk.

Remainder of SWMU

Current/Future On-Site Laborer. As summarized in Table 4-60, the summed HI for all pathways does not exceed unity (one). The total HI for all pathways range from 2.6E-02 and 2.6E-04 for the RME and CTE scenarios, respectively. In the RME scenario, the driving pathway is ingestion of surface soil, which contributes 89 percent of the total HI. The inhalation pathway could not be evaluated because inhalation reference doses for the COPCs were not available at the time of this report.

Future On-Site Adult Resident. As summarized in Table 4-61, the summed HI for all pathways is below unity (one). The summed HI for the RME and CTE scenarios is 4.3E-01 to 1.1E-01, respectively. In the RME scenario, the driving pathway is ingestion of produce, which contributes 86 percent of the total HI. The inhalation pathway could not be evaluated because inhalation reference doses for the COPCs were not available at the time of this report.

Future On-Site Child Resident. As summarized in Table 4-62, the summed HI for all pathways is below unity (one). The summed HI for the RME and CTE scenarios is 6.0E-01 and 2.1E-01, respectively. The driving pathway is ingestion of produce, leafy vegetables, tubers, and fruits, which contribute 67 percent of the total HI. The inhalation pathway could not be evaluated because inhalation reference doses for the COPCs were not available at the time of this report.

SWMU 35 as a Whole

Current/Future On-Site Laborer. As summarized in Table 4-63, the summed HI for all pathways does not exceed unity. The total HIs for all pathways range from 6.8E-02 and 7.1E-04 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of surface soil, which contributes 60 percent of the total HI. The inhalation pathway could not be evaluated because inhalation reference doses for the COPCs were not available at the time of this report.

Future Recreational Visitor. As summarized in Table 4-64, the summed HI for all pathways does not exceed unity (one). The total HIs for all pathways range from 1.3E-02 and 2.1E-03 for the RME and CTE scenarios, respectively. The driving pathway is dermal contact with surface soil (75 percent) for the RME scenario and ingestion of surface soil (72 percent) for the CTE scenario. The inhalation pathway could not be evaluated because inhalation reference doses for the COPCs were not available at the time of this report.

4.3.4.7 *Risk Assessment Summary and Conclusions*

A baseline risk assessment addendum was conducted for the Wastewater Spreading Area (SWMU 35) based on Phase I and Phase II RI data. Several current and future-use scenarios

were quantitatively evaluated:

- On-site laborer/security worker
- Construction worker (during redevelopment)
- Recreational user (after redevelopment)
- On-site resident (after redevelopment)

For each scenario, an RME and a CTE were evaluated (Tables 4-65 and 4-66). All scenarios, except that of the RME and CTE future resident at the Ditches West of the Stable Area, were found to fall within or below the target ranges for tolerable ILCRs and HIs. Four pathways were evaluated as part of the residential scenario:

- Ingestion of surface soil
- Dermal contact with surface soil
- Ingestion of homegrown produce, which is subdivided into leafy vegetables plus tubers and fruits
- Inhalation of potentially resuspended particulates

ILCRs for both adult and child RME residents were on the order of 10^{-4} to 10^{-5}. The adult and child resident HQ for ingestion of tubers and fruits ranged from 1.1 to 11.0 for the Ditches West of the Stable Area. It should be remembered that any estimate of risk is dependent on the concurrent validity of all assumptions used to construct the exposure model. In other words, the estimates rely on several activities recurring with constant intensity and in predictable order. For example, produce ingestion assumes a constant consumption rate every day for durations up to 30 years for adults and 18 years for children. The following sections catalogue conservative assumptions and approaches used in the SWMU 35 RA.

4.3.4.7.1 ***Exposure Point Concentrations.*** EPCs for residential exposure are based on field data collected in the time frame 1992 through 1994. No residence currently exists on SWMU 35. If, at some future time, residences are built, the necessary construction activities would greatly alter the EPCs through the likely addition of fill and mixing.

4.3.4.7.2 ***Exposure Scenario Formulation and Assessment.*** The data collected are from the ditch and spreading area and, therefore, the exposure activities (including the location of the residence itself) are spatially confined to these areas. This, of course, is highly unlikely. If, as suspected, the pesticide residues are concentrated in the ditch as a result of runoff, areas on which a residence might be built would be expected to show evidence of lower concentrations and, thereby, lower risks.

Inhalation was quantitatively evaluated as if no vegetative cover and other residential landscaping would be present to eliminate significant wind erosion and particulate resuspension. Most of the current study area has vegetative cover. In addition, the lack of recent sources for pesticides would lead to the conclusion that possible small volatile components that may have existed have dissipated.

Table 4-65. Summary of RME Risk Results for SWMU 35

Scenario	Ditches West of the Stable Area		Remainder of SWMU		SWMU as a Whole	
	HI[a]	ILCR[d]	HI	ILCR	HI	ILCR
Current Land Use						
On-site Laborer	4.1E-02	1.3E-06	2.6E-02	4.2E-06	6.8E-02	5.3E-06
Future Land Use						
On-site Adult Resident	5.9E+00	2.4E-04	4.3E-01	7.7E-05	---[c]	---
On-site Child Resident	1.0E+01	2.6E-04	6.0E-01	6.6E-05	---	---
Recreational Visitor	---	---	---	---	1.3E-02	9.5E-07

[a]Hazard Index.
[b]Incremental Lifetime Cancer Risk
[c]Scenario not evaluated.

Table 4-66. Summary of CTE Risk Results for SWMU 35

Scenario	Ditches West of the Stable Area		Remainder of SWMU		SWMU as a Whole	
	HI[a]	ILCR[b]	HI	ILCR	HI	ILCR
Current Land Use						
On-site Laborer	3.9E-02	2.5E-09	2.6E-04	5.7E-09	7.1E-04	7.1E-09
Future Land Use						
On-site Adult Resident	1.1E+00	1.2E-05	1.1E-01	5.6E-06	---[c]	---
On-site Child Resident	1.8E+00	2.0E-05	2.1E-01	1.1E-05	---	---
Recreational Visitor	---	---	---	---	2.1E-03	6.4E-08

[a]Hazard Index.
[b]Incremental Lifetime Cancer Risk
[c]Scenario not evaluated.

4.3.4.7.3 *Risk Characterization*. Food-chain pathways (i.e., home gardening) are significant contributors to total risks. According to Lee Sherry, a home economist with the Utah State University Agricultural Extension Service in Tooele, saline content in area soils generally require home gardeners and landscapers to replace or augment the existing soil with new topsoil. The above observation is confirmed by soil testing results from the Utah State University Soil Testing Laboratory (Appendix G).

Models used to estimate uptake into edible portions of plans have been shown to overestimate that uptake. For example, in the United Kingdom, studies of crops grown in soils near mining operations that are heavily contaminated with arsenic do not show appreciable arsenic uptake. In Poland, vegetables grown in high arsenic containing soils near power stations, superphosphate plants, and smelters all measure less than 0.2 μg/g wet weight (O'Neill 1990). This is an order of magnitude less than that predicted by the models used in this risk assessment employing the transfer coefficients developed by Baes and coworkers (1984).

When site-specific conditions are considered along with the conservative assumptions designed to offset assessment uncertainties, the risk estimates for the future residential scenario are, in point of fact, likely to be overestimates. Based on the available analytical data and the above considerations, the risk assessment results indicate that there is no immediate and substantial danger to human health from the presence of low levels of hazardous chemicals at SWMU 35. Therefore, it appears that the No Further Action remedial alternative may be appropriate for this SWMU.

4.3.5 Conclusions and Recommendations

The Phase II RI investigation conducted at SWMU 35 consisted of analyses for pesticides in surface and subsurface soils as well as metals at four soil sample locations. Pesticides and metals were found in soil at this SWMU. A sample was also collected from water supply well WW1 to determine the potential migration of contaminants to groundwater. The analyte suite consisted of pesticides, VOCs, SVOCs, metals, and explosives. None of the analytes detected in the groundwater samples exceeded their respective MCLs.

A baseline human health risk assessment was conducted at SWMU 35 to determine any potential human health risks associated with a no-action alternative. COPCs were evaluated in both surface and subsurface soil and groundwater utilizing both Phase I and Phase II data. Arsenic, delta-benezenehexachloride, alpha-chlordane, gamma-chlordane, alpha-endosulfan, endrin, heptachlor, and heptachlor epoxide were the COPCs retained for further evaluation in soil based on the USEPA Region III soil screening criteria. There were no groundwater COPCs retained for further evaluation. Based on the results of the human health risk assessment, no significant concern for human health exists at the Wastewater Spreading Area. All scenarios except the hypothetical future resident were found to fall within or below the target ranges for ICLRs and HIs. ICLRs and HIs for both adult and child RME future resident exceed the upper bound of the target risk range. Future on-site adult resident risk values for total CTE ILCR equaled 1.2E-05 and total RME ILCR equaled 2.4E-04. Future on-site child

resident risk values for total CTE ILCR equaled 2.0E-05 and total RME ILCR equaled 2.5E-04. As explained in Sections 3.1.5 and 4.3.4.5, the assumptions used in these estimates are conservative. HIs for the future adult resident were 1.1 and 5.9 for the CTE and RME, respectively. HIs for the future child resident were 1.8 and 10 for the CTE and RME, respectively. These exceedances were in the Stable Area. The remainder of the SWMU had no ICLRs or HI exceeding risk-based criteria. Soil excavation is one possibility for eliminating the future land use risk. This will be further evaluated in the FS. Also, it is important to note that additional soil sampling for thallium may be necessary prior to releasing the land for future residential use. This information will be carried through the FS and ROD process.

Human health risk assessment results do not indicate a significant concern to current human health scenarios. Therefore, it is recommended that no further remedial investigations are necessary. A feasibility study will be conducted for SWMU 35, as required by CERCLA, to determine if any other remedies are required for this SWMU. Conclusions from this report and the SWERA will be used during the FS process to derive final recommendations for SWMU 35. Additionally, BRAC parcel data should be evaluated when determining final recommendations.

Ecological risk results for SWMU 35 are presented in the TEAD SWERA report (Rust E&I 1996).

5.0 OPERABLE UNIT 8

OU 8 consists of six SWMUs in the southwestern portion of TEAD-N: the Old Burn Area (SWMU 6), the Chemical Range (SWMU 7), the Tire Disposal Area (SWMU 13), the Building 1303 Washout Pond (SWMU 22), the Bomb and Shell Reconditioning Building (SWMU 23), and the Old Burn Staging Area (SWMU 36). SWMU 6 is an area that was used for the testing of munitions, fuses, and propellants and the burning of crates and boxes. SWMU 7 is an area that was used for the testing of chemical and pyrotechnic-type munitions, excluding agent-filled munitions. It has been divided into three sub-areas: (1) the firing course itself, including the bullet stop; (2) the firing point at the east end, which includes two covered trenches that had been used for the disposal of munitions after testing; and (3) an open trench located northwest of the firing point. SWMU 13 consists of a large pit, which resulted from previous gravel mining operations and which was used from 1965 to 1993 for the disposal of unreclaimable tire carcasses. SWMU 22 reportedly received washdown water from Building 1303, where sawing of munitions was conducted. SWMU 23 was used for performing external work (i.e., sandblasting and painting) on large munitions. SWMU 36 is a former gravel pit that was used for the staging of materials to be burned or disposed of at SWMU 6. This section presents the previous investigation and Phase I and Phase II RI results for the six SWMUs in this OU.

5.1 OLD BURN AREA (SWMU 6)

5.1.1 Site Characteristics

The Old Burn Area (SWMU 6) is located in the south-central portion of TEAD-N outside of the BRAC parcels and consists of a gently sloping, grassy area with three bermed revetments located in the eastern portion of the SWMU (Figure 1-2). Four natural surface drainages run off the north side of SWMU 6, where they are intercepted by a manmade drainage ditch. This ditch carries the runoff to the northwestern corner of the SWMU where it exits via a culvert under the access road. The site was used until the 1970s for the testing of hydrocarbon-filled smoke munitions, fuses, and propellants. It was also used for the widespread burning of wooden boxes and crates on the surface and in shallow trenches. A review of EPIC aerial photographs shows that various trenching activities occurred from the 1950s to the 1970s. All of the former trenches have been filled, and the area has been graded and revegetated since use of the area for testing and burning was discontinued. Geophysical surveys conducted by Weston (1990) and Rust E&I (1992) detected several areas of buried metal wastes. According to the aerial photographs and the geophysical surveys, the revetment area in the eastern portion of the area contained several buried trenches, which contain the highest concentration of buried metal waste in the SWMU 6 area. Several test pits were excavated and sampled in this area as well as other locations of geophysical anomalies throughout SWMU 6 (see Section 5.1.2). Some of the test pits contained spent or destroyed munitions and debris. Although the material that was encountered in the pits was not live, live UXO could possibly be present in the portions of the trenches and geophysical anomalies where no test pits were excavated. As noted above, widespread burning occurred at this SWMU, further decreasing the likelihood that live UXO is present at SWMU 6.

5.1.2 Previous Investigations and Phase I and Phase II RI Activities

Weston (1990) conducted geophysical surveys over a portion of the Old Burn Area to define the locations of former trenches that were observed in the aerial photographs. The geophysical surveys identified several target areas, and a drilling program of four soil borings was conducted. Weston drilled the four soil borings adjacent to, but not in, the former trenches because of safety concerns. The borings were drilled to a depth of 50 feet, and soil samples were collected and analyzed for explosives, metals, and anions. Results of the sampling and analysis indicated possible metals contamination of the site soils adjacent to the suspected former trenches. No explosives or anions were detected.

During the Phase I RI (Rust E&I 1992), a geophysical survey was conducted across the entire area of SWMU 6 to verify and further define target areas identified during the Weston investigation (1990). The 1992 survey also investigated other areas south of the previous survey, which are shown as trenched and disturbed areas on historical photographs. The detailed survey successfully identified several areas of geophysical anomalies. Three of the target areas defined by the geophysical survey were selected for test pit excavation and sampling as shown in Figure 5-1. A fourth test pit was excavated and sampled in an area identified on the basis of visual observations. In addition, two exploratory pits were excavated, but not sampled, in a geophysical target area in the southwestern portion of the SWMU. Samples collected were analyzed for explosives, metals, SVOCs, and anions. All of the soils were scanned with an HnU for VOCs, but none were detected.

One test pit (Test Pit No. 2) was located within the revetment area of the SWMU where several trenches were shown on historical photographs and verified by the geophysical survey. A variety of munitions-related debris was encountered in this test pit. Soil samples collected contained very high levels of a variety of metals, with a maximum concentration of 12,000 μg/g of lead. Test Pit No. 1, located just to the northwest of the revetment, was found to contain metal banding left over from the burning of boxes and crates in the area. Soil samples collected from this test pit also contained elevated concentrations of several metals (with a maximum concentration of 1,200 μg/g of zinc). Test Pit No. 3, to the south of the revetment, contained explosives at depths of 1 foot and 5 feet and mercury at 0.0776 μg/g at the 5-foot depth. Test Pit No. 4, located in the western portion of the SWMU, contained explosive contaminants to a depth of 7.5 feet. Soil samples collected below the depth of buried materials generally contained background concentrations of analytes, indicating that vertical migration of contaminants had not occurred. The horizontal extent of metals and explosives contamination was not defined for any of the contaminated areas. Although PAHs are a suspected contaminant where combustion occurred, analysis for SVOCs found only scattered, very low (less than 2 ppm) detections of phthalates and N-nitroso-diphenylamine.

Phase II RI field activities were performed by Rust E&I at SWMU 6 in the summer of 1994. Additional investigation of the trenches within the revetment area of SWMU 6 was warranted because of the variety of materials found and the elevated concentrations of contaminants identified in the subsurface soils at this site during the Phase I RI. UXO clearance was

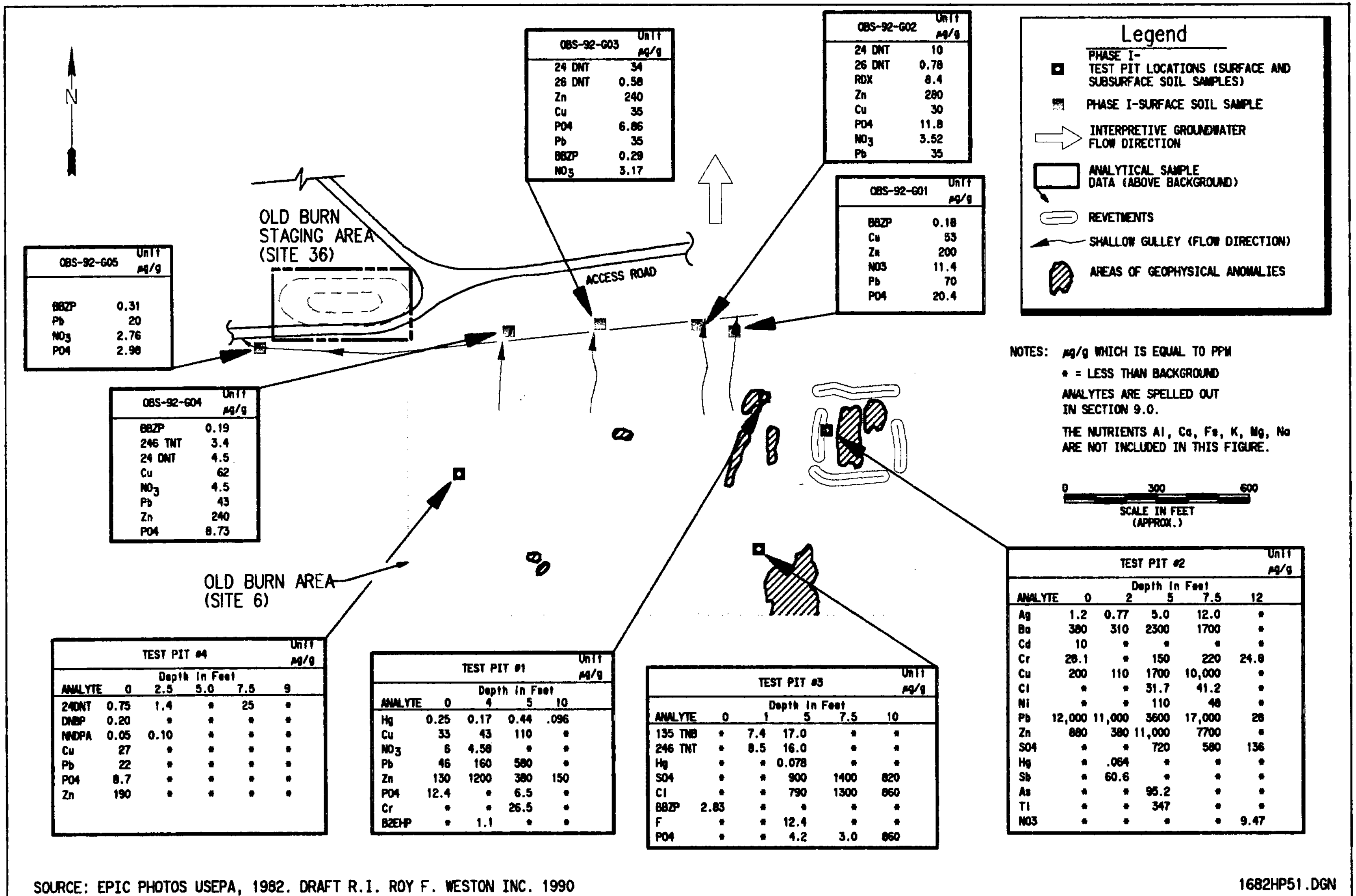


Figure 5-1. Phase I RI Sample Location Map and Results for the Old Burn Area

performed at this SWMU prior to any work and during the test pit activities. Eleven additional test pits and two observation pits were excavated in the unevaluated target areas defined by the Phase I geophysical anomalies (Figure 5-2). The two observation pits were excavated across a raised berm feature in the middle of the revetment area. Originally, 10 test pits were proposed, but 1 extra test pit was added to characterize the contamination associated with one of the observation pits found to contain burned material.

Five test pits and the two observation pits were located in the revetment area, and the remaining six test pits corresponded to unevaluated Phase I geophysical anomalies throughout the SWMU. The test pits were excavated to a depth of 10 feet. Soil samples were collected from each test pit at depths of 0 to 6 inches, 2 feet, 5 feet, 7 feet, and 10 feet. All soil samples collected at the Old Burn Area were analyzed for explosives and metals. In addition, all soils were scanned with an HnU for VOCs, but none were detected at SWMU 6. During the excavation of the test pits, a variety of buried materials were uncovered, ranging from steel banding (used for wooden boxes) to burned munitions. Some of this debris was uncovered in buried trenches with distinct burn horizons, and much of it was found scattered in with the fill material. Distinctive burn horizons were observed in test pits OBP-94-02, -04, and -05, and in the two exploratory trenches located within the revetment area. More evidence of burning in the trenches was found in test pits OBP-94-07 and -08, located west of the revetments in a surface depression with metal debris piled on the surface. Debris was found scattered in with the fill material in test pits OBP-94-01, -09, -10, and -12. Surface soils within test pits OBP-94-03 and -06 appeared to have been previously disturbed; however, no debris was encountered during excavation. The test-pit logs generated during each test-pit excavation are presented in Appendix B. A photograph of one of the test pits during excavation is shown in Appendix C.

Due to a concern that burning activities in trenches at SWMU 6 may have released dioxins/furans to subsurface soils, additional Phase II RI test pit excavation and sampling were conducted in November 1995 at locations with previously identified subsurface burn horizons. Test Pits OBP-95-01 and OBP-95-02, corresponding to previous test pits OBP-94-02 and OBP-94-05, respectively (Figure 5-2), are located in the former trenches within the revetment at SWMU 6. They were excavated to a depth approximately 2 feet below the burn horizon with samples collected for dioxins/furans analysis at the surface, within the burn horizon, and 2 feet below the horizon. Test Pits OBP-95-03 and OBP-95-04, corresponding to previous test pits OBP-94-07 and OBP-94-08, respectively (Figure 5-2), are located in former trench locations west of the revetment at SWMU 6 and were also sampled at the surface, within the burn horizon, and 2 feet below.

Surface soil sampling was required to address the possible transport of contamination northward by surface water runoff and to confirm that the primary contamination at this SWMU is confined to the subsurface soils related to previous pits and trenches. Thirty-two surface soil samples were collected over the entire SWMU during the Phase II RI. The surface soil locations were determined using an approximate north/south and east/west grid for complete coverage of the Old Burn Area, including the area north of the gullies (Figure 5-3).

To address the concern that surface burning of debris at SWMU 6 may have resulted in dioxins/furans surface soil contamination, the entire SWMU 6 area was again gridded in November 1995, and 28 additional surface soil samples were collected for dioxins/furans analysis at SWMU 6 (Figure 5-4). Additionally, four dioxin/furan background samples were collected (see Figure 2-2). To address the potential that surface water runoff in the gullies prior to construction of the manmade interceptor ditch caused contamination of soils in the discharge areas, eight additional sediment samples (OBS-95-29, -30, -31, -32, -33, -34, -40, and -41) from four gullies were collected north of the ditch in November 1995 for metals and explosives analysis (Figure 5-3).

5.1.3 Contamination Assessment

5.1.3.1 *Data Evaluation*

This section evaluates the analytical data for its usability in the risk assessment. A data evaluation was performed by reviewing the data quality codes assigned by the USAEC Chemistry Branch and EcoChem, an independent third-party validator. In an effort to ascertain the level of certainty/uncertainty, USEPA data qualifiers were then assigned as an aid in interpreting the data for use in the risk assessment. (Table 2-4 defines the relationship between the USAEC Chemistry Branch codes and USEPA data qualifiers.) The following sections summarize the results of this process.

5.1.3.1.1 ***Field Duplicates.*** The "D" flag code represents a field duplicate. All "D" flagged data were compared with the primary investigative result, and the higher of the two values was used in the quantitative risk assessment.

5.1.3.1.2 ***Blank Assessment.*** The USEPA has determined that when blank contamination exists, the investigative results must exceed the blank result by a factor of 5 (all compounds) or 10 (common laboratory contaminatants such as acetone) in order to be considered positive. Butylbenzyl phthalate, acetone, methylene chloride, nitrate, and several metals were detected in method and or other blanks associated with SWMU 6 soil samples. Based on comparisons to blanks, positive results were changed to nondetects for the following samples. According to USEPA guidance (USEPA 1989), the associated blank concentration was considered the quantitation limit for the affected samples.

- Surface Soil (0 to 0.5 foot)
  –Butyl benzyl phthalate—OBS-92-401
  –Manganese—OBP-94-03A

- Subsurface Soil (0.5 to 12 feet)
  –Acetone—OBP-92-101, -201, -301 and -401
  –Butyl benzyl phthalate—OBP-92-401, -403, and -404
  –Methylene chloride—OBP-92-101, -202, -301 and -401
  –Nitrate—OBP-92-301, -302, -304, and -402

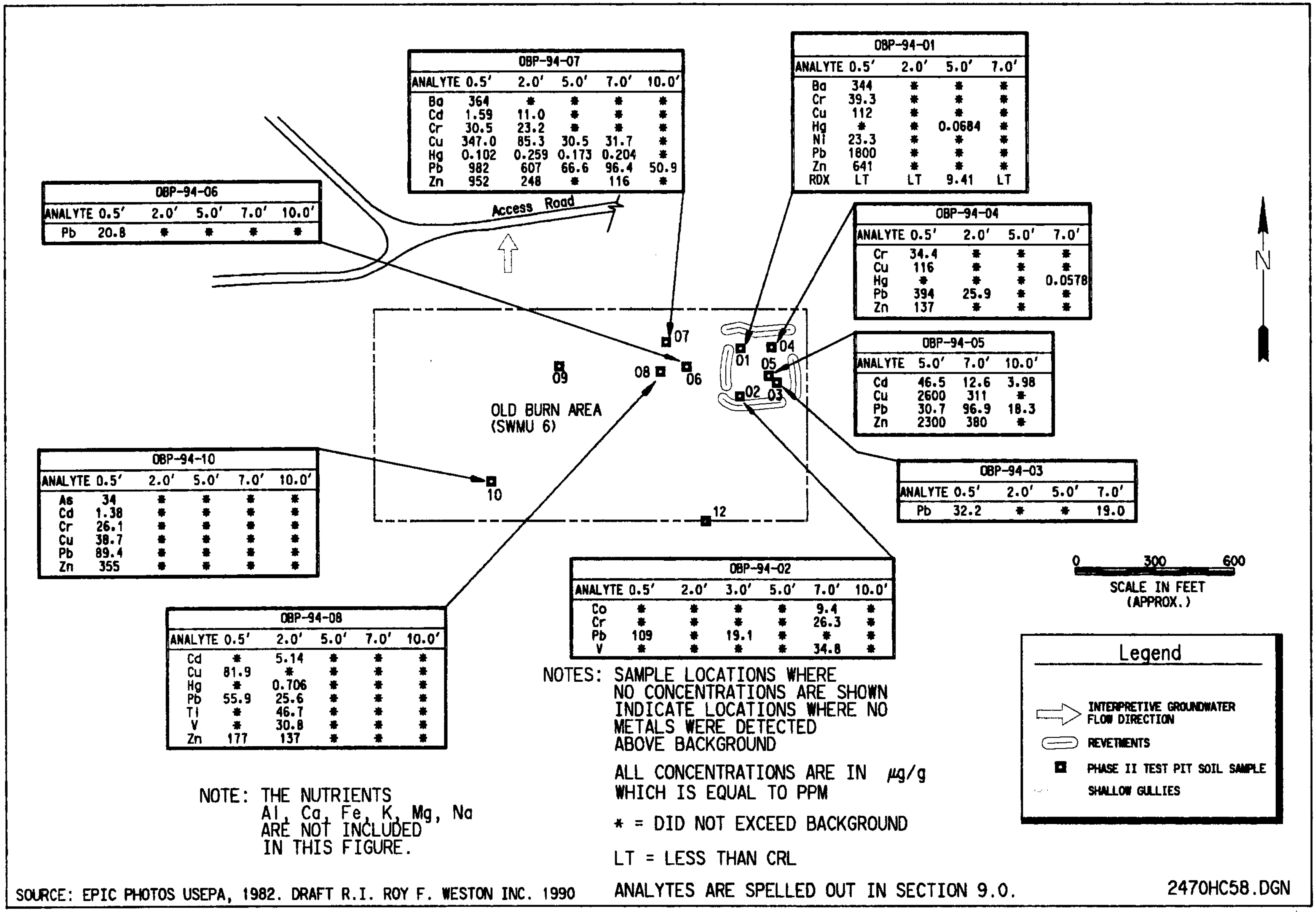


Figure 5-2. Phase II Test Pit Sample Location Map and Results

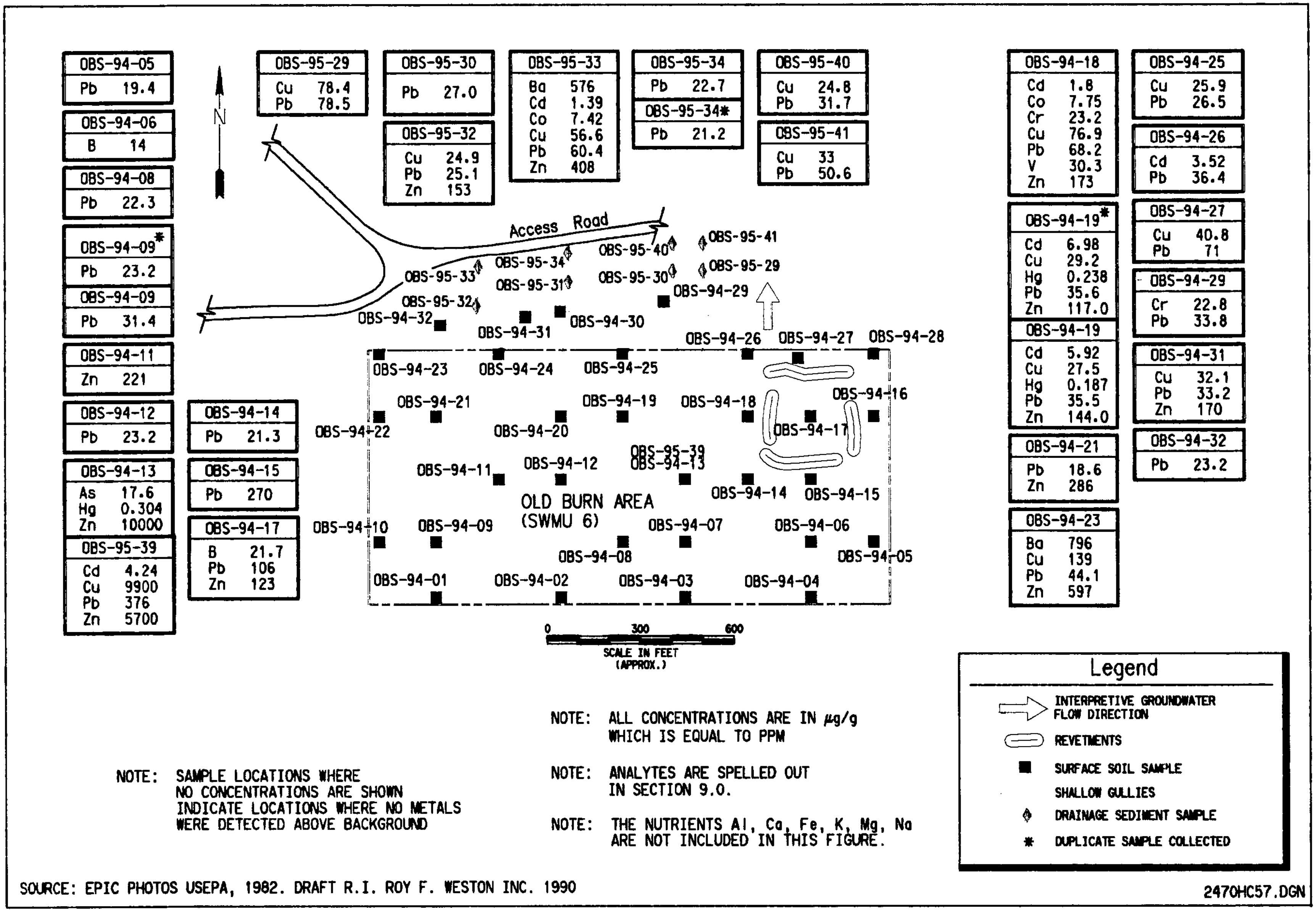


Figure 5-3. Phase II Surface Soil Sample Locations and Results

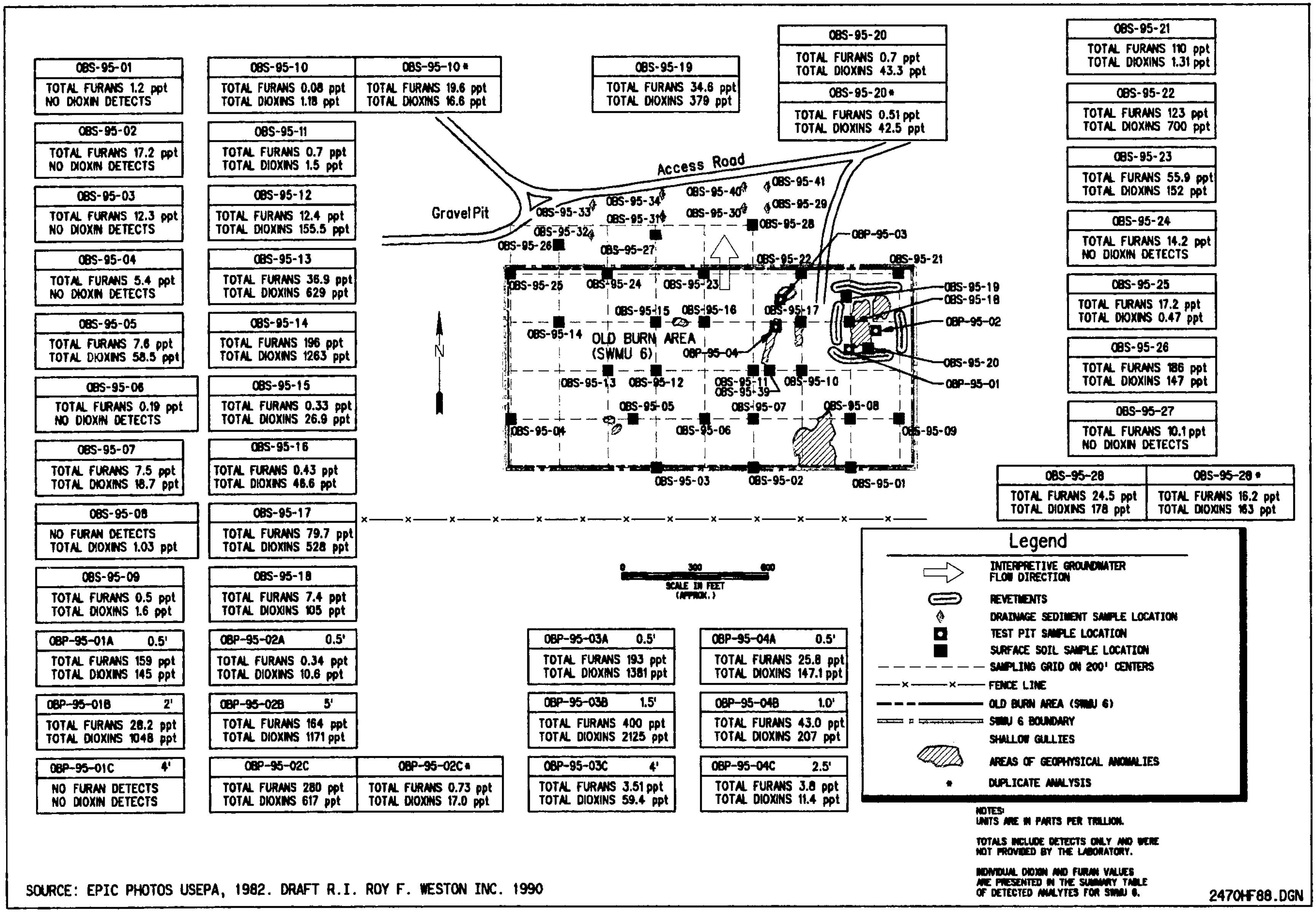


Figure 5-4. Phase II Dioxin/Furan Soil Sample Locations and Results

-Aluminum—OBP-94-01C, -01D, -02B, -02C, -03B, -03C, -03D, -05D, -05E, -06C, -06D, 06E, -07C, -07E, -08C, -8D, 08E, 09E (and duplicate), -10C, -10D, and -10E
-Barium—OBP-94-02B, -02C, -03B, -03C, 03D, -05D, -05E, -06E, -08D, -08E, and -10E
-Chromium—OBP-94-02B, -02C, -02E, -03B, -03C, -03D, -05E, -06C, -06E, -08D, and -08E
-Iron—OBP-94-01C, -01D, -02B, -02C, -03B, -03C, -03D, -05D, -05E, -06C, -06D, -06E, -07C, -08C, -08D, and -08E
-Magnesium—OBP-94-02B, -02C, and -03B
-Manganese—OBP-94-01B, -02B, -02C, -02E, -03B, -03C, -03D, -05D, -5E, -06C, -06D, -06E, -08C, -08D, -08E, -09C (and duplicate), -09E (and duplicate), -10E, and -12E
-Potassium—OBP-94-01C, -02B, -02D, -03C, -02C, -03C, -03D, -05D, -05E, -06C, -06D, -06E, -07C, -07E, -08C, -08D, -08E, -09E (and duplicate), and -10D, and -10E
-Vanadium—OBP-94-01C, -01D, -02C, -02E, -03C, -03D, -5C, -5D, -5E, -06C, -06D, -06E, -07C, -07D, 08E, -08D, -08E, -09C (and duplicate), -09E (and duplicate), -10C, -10D, -10E, and -12E
-Zinc—OBP-94-02C, -03C, -03D, -06C, -06D, -06E, -08C, -08E, -09C (duplicate only), -09E (and duplicate), -10E, and 12E

5.1.3.1.3 ***Duplicate Data from Different Methods.*** Both 2,4-dinitrotoluene and 2,6-dinitrotoluene were analyzed as explosives (HPLC) and as SVOCs (GC/MS) for 1992 samples in the SWMU 6 data set. For a given sample, if there was a detection with one method, the detected value was used in the risk assessment. If both values were detects, the highest detected value was used. If both values were nondetects, 1/2 of the lower nondetect value was used. For 1994 samples, these chemicals were analyzed for explosives by HPLC only.

5.1.3.1.4 ***USAEC Chemistry Branch Validation.*** The USAEC Chemistry Branch reviewed the analytical data for technical deficiencies based on the *USATHAMA (USAEC) Quality Assurance Program (PAM 11-41)*. USAEC data quality codes assigned by the Chemistry Branch would be an indication of QC recoveries outside of USAEC control limits and other technical deficiencies. Estimating or rejecting the data for use in the risk assessment based on USAEC codes is judged to be conservative, since USAEC control limits are generally narrower than USEPA Functional Guidelines. All USEPA data qualifiers that were assigned based on USAEC data quality indicators are provided in the analytical summary tables of Appendix J.

For SWMU 6, the USAEC Chemistry Branch assigned qualifiers to antimony (Lot ANJZ), vanadium (Lot ANJH), and 1,3,5-trinitrobenzene (Lots AMVC and AMVE) results because of poor low-spike recoveries. These data were estimated (J-coded) for use in the risk assessment because of a low recovery bias. The USAEC Chemistry Branch also noted high low-spike recovery values for mercury in Lots ANEU and ANGI. For use in the risk assessment, detected values for mercury in these lots were estimated (J-coded) as potentially biased high. No data were rejected for use.

Non-Certified Compounds. USAEC flag codes of R or T were assigned by the analytical laboratory to indicate non-detected compounds that had not been performance demonstrated or validated under the USAEC's 1990 QA program. Under this program a distinction is made between "target" and "non-target" analytes. "Target" compounds are determined during the certification process, and CRLs for those analytes are established. "Non-target" compounds are those that were added to the method to meet project-specific requirements, and the lowest calibration standard used for that analyte typically reflects the "practical quantitation level" (PQL). Many of the "non-target" compounds initially flagged R or T were subsequently certified under the USAEC's QA program and are not flagged as such in later analyses. As a conservative approach for the purpose of the risk assessment, quantitation limits for R or T flagged compounds were assigned a J-code, due to any uncertainty associated with not having undergone a rigorous certification process.

5.1.3.1.5 ***Independent Third-Party Data Validation.*** A data quality assessment was completed using a validation effort by EcoChem, an independent third party. EcoChem's review and recommendations were based on USEPA Functional Guidelines as well as the *USATHAMA (USAEC) Quality Assurance Program (PAM 11-41)* and individual methods. All USEPA data qualifiers recommended by EcoChem were incorporated for use in the risk assessment and are provided in the analytical summary tables of Appendix J.

For Phase II RI data collected in 1994, EcoChem evaluated one lot of selenium soil analyses by Method JD20, one lot of ICP-metal analyses of soil samples by Method JS12, and three lots of explosive analyses of soil samples by Method LW23

For the selenium analyses in Lot ANKC, EcoChem found all results acceptable for use without qualification.

For the ICP-metals analyses in Lot ANUC, EcoChem rejected (R) all antimony detection limits due to 0 percent recovery in the MS/MSD, indicating the possibility of false non-detects. The USAEC did not flag this problem because natural spikes are not part of the USAEC QA program.

For the three lots of explosive data, Lot ANFY was found to be acceptable for use without qualification; Lot AMVC had all 1,3,5-trinitrobenzene results rejected (R) due to poor low-spike recovery values (the USAEC Chemistry Branch also flagged this problem); and Lot ANDS had all 1,3,5-trinitrobenzene results qualified as estimated (UJ) also due to poor standard spike recoveries.

For Phase I RI data collected in 1992, EcoChem evaluated two lots of explosive analyses of soil samples by Method LM26, and one lot of lead analyses of soil samples by GFAA Method JD13. They noted all data were viewed as acceptable for use without qualification.

One parathion sample result was also rejected as part of EcoChem's review of semivolatile data in Lot SJU for SWMU 6.

Listed below are the sample results rejected for use in the risk assessment.

- Surface Samples
  -Antimony - OBS-94-29 through -32
  -1,3,5-Trinitrobenzene - OBP-94-01A
  -Parathion - OBS-92-G01

- Subsurface Samples
  -1,3,5-Trinitrobenzene - OBP-94-01B, -01C, 01D

5.1.3.1.6 ***Data Evaluation Summary.*** A total of 92 surface soil samples and 65 subsurface soil samples were collected in 1992, 1994, and 1995 from 19 test pits and 74 surface locations at SWMU 6. Test pit samples were collected at multiple depths down to 10 feet. Samples were analyzed for one or more of the following groups of chemicals: volatiles, semivolatiles, anions, metals, explosives, and dioxins/furans.

Because of blank contamination, positive results for a number of metals were changed to nondetects. However, the detected values in the affected samples were below background screening levels for the metals, indicating that this issue does not significantly impact the risk assessment results.

Blank contamination with dioxins/furans (primarily hexa-, hepta-, and octa-congeners) also resulted in a number of these samples being converted to nondetects. Taking into account 2,3,7,8-TCDD equivalency, the detected concentrations in the affected samples were below the ingestion RBC for 2,3,7,8-TCDD. Therefore, this issue does not significantly impact the risk assessment results.

Antimony and thallium reporting limits for samples collected in 1992 and 1994 exceeded their respective background screening values. However, antimony and thallium were either not detected or were detected below background in all 10 surface soil samples collected and analyzed for metals in 1995, including one in the northeast revetment area. Reporting limits for antimony and thallium for the 1995 data were both 1.0 $\mu g/g$. The latest results indicate that the prior reporting limit issue for these metals also is not likely to significantly impact the risk assessment results.

Although cadmium reporting limits were higher than the background screening value in all sampling rounds, they were below both the ingestion and soil-to-air RBCs. This issue, therefore, does not significantly impact the risk assessment results for this chemical.

Four antimony nondetect results, four 1,3,5-trinitrobenzene nondetect results, and one parathion nondetect result were rejected due to poor spike recoveries or low response factors.

Over 99 percent of sample results were judged to be usable for risk assessment purposes. The number of samples and the analytical parameter list appear to be sufficient to characterize the nature, extent, and potential magnitude of contamination at this SWMU. A summary of

chemicals detected in at least one surface or subsurface soil sample at SWMU 6 is presented in Appendix J, including data qualifiers (as appropriate) according to USEPA functional guidelines.

5.1.3.1.7 ***Background Screening.*** The maximum concentrations of inorganic chemicals detected in soil at SWMU 6 were compared to the site-specific background screening values (see Section 2.6). Any inorganic chemical detected in at least one sample at a concentration higher than the background screening value was retained in the COPC database. Surface soil and subsurface soil were screened separately. The results of the background screening are shown in Table 5-1.

Based on this screening analysis, aluminum, antimony, beryllium, calcium, and manganese are the only inorganic analytes that are <u>not</u> considered potential contaminants at SWMU 6 in surface soil. In subsurface soil, all inorganic analytes <u>except</u> beryllium and manganese are potential contaminants.

Cadmium, silver, and thallium, each of which was detected infrequently, had high CRLs when compared to background threshold values.

Chlorinated dioxins and furans were also detected in soils at this SWMU. Because these compounds are frequently encountered in the environment as anthropogenic background, site dioxins/furans were compared to background dioxins/furans to determine if the congeners detected in soil at the SWMU are related to site activities or are consistent with anthropogenic background. This comparison was performed in two ways.

First, the profiles of the congeners within individual samples collected at the SMWU were compared to the profiles of the congeners in four background samples (BKS-95-06, -07, -08, and -09). In general, the lower chlorinated congeners degrade quickly in the environment, leaving behind the higher chlorinated congeners, which can persist for hundreds of years (Bumb *et al.* 1980; Nestrick *et al.* 1986; Smith *et al.* 1983). For comparison purposes, bar graphs, which are presented in Appendix R, were constructed using *total* concentrations of each the various congeners within a sample. Although the graph scale is different for each sample, the graphs are presented only to illustrate the overall pattern of the congener distribution within the samples (not to compare total dioxin/furan concentrations among the samples). The background samples show the typical pattern in which the hepta- and octa-congeners predominate, although in sample BKS-95-09 the concentration of the octa-congener is not as high compared to the lower chlorinated compounds. For the majority of site samples, the hepta- and octa-congeners predominate as well, which is suggestive of background anthropogenic contamination and not more recent site-related activities.

In two instances, the congener pattern within a surface sample deviated from typical background. SWMU 6 sample OBS-95-01 showed only a TCDF concentration of 1.2E-06 μg/g (2,3,7,8-TCDD-equivalent concentration of 1.2E-07 μg/g). SWMU 6 sample OBS-95-06 had a detection 1.9E-07 μg/g of 1,2,3,4,7,8-hexachlorodibenzofuran (2,3,7,8-TCDD-

Table 5-1. Background Screening of Inorganic Chemicals Detected in Soil at SWMU 6

Chemical	Frequency of Detection[a]	Maximum Detected Value (μg/g)[b]	Site-specific Background Screening Value[c] (μg/g)	Exceeds Site-specific Background?
Surface Soil				
Aluminum	50/51	25,000	28,083	No
Antimony	3/56	3.26	15	No
Arsenic	51/60	34	11.69	YES
Barium	59/60	796	247	YES
Beryllium	35/60	1.09	1.46	No
Cadmium	8/60	10	0.847	YES
Calcium	50/51	32,000	114,483	No
Chromium	59/60	39.3	20.62	YES
Cobalt	48/51	7.75	6.94	YES
Copper	59/60	9,900	24.72	YES
Iron	59/60	39,000	22,731	YES
Lead	57/60	12,000	18.23	YES
Magnesium	50/51	9,870	7,062	YES
Manganese	49/51	673	698	No
Mercury	7/60	0.304	0.0572	YES
Nickel	51/60	23.3	17.40	YES
Potassium	50/51	7,260	5,450	YES
Silver	9/60	1.2	0.66	YES
Sodium	50/51	654	337	YES
Vanadium	46/51	30.3	28.39	YES
Zinc	59/59	5,700	102.8	YES
Subsurface Soil				
Aluminum	20/41	28,100	28,083	YES
Antimony	1/57	60.6	15	YES
Arsenic	32/57	95.2	11.69	YES
Barium	46/57	2,300	247	YES
Beryllium	7/57	1.08	1.46	No
Cadmium	5/57	46.5	0.847	YES
Calcium	41/41	140,000	114,483	YES
Chromium	43/57	220	20.62	YES
Cobalt	22/41	9.4	6.94	YES
Copper	50/57	10,000	24.72	YES
Iron	41/57	290,000	22,731	YES
Lead	34/57	17,000	18.23	YES
Magnesium	38/41	14,100	7,062	YES
Manganese	22/41	534	698	No
Mercury	16/57	0.706	0.0572	YES
Nickel	34/57	110	17.40	YES
Potassium	21/41	7,260	5,450	YES
Silver	12/57	12.0	0.66	YES

Table 5-1. Background Screening of Inorganic Chemicals Detected in Soil at SWMU 6 (continued)

Chemical	Frequency of Detection[(a)]	Maximum Detected Value (μg/g)[(b)]	Site-specific Background Screening Value[(c)] (μg/g)	Exceeds Site-specific Background?
Sodium	39/41	2,310	337	YES
Thallium	2/57	347	11.70	YES
Vanadium	13/41	34.8	28.39	YES
Zinc	41/57	11,000	102.8	YES

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]Micrograms per gram.
[c]See Section 2.6.1.1 for an explanation of how the site-specific background screening values were calculated.

Table 5-2. Summary of Dioxin/Furan Data for SWMU 6

Sample Location	Frequency of Detection	Range of Detected Values ($\mu g/g$)[a]	Range of Reporting Limits ($\mu g/g$)
SWMU 6 surface	32/32[b]	1.0E-08 -3.6E-05	NA[c]
SWMU 6 subsurface	7/8	7.9E-08 - 7.1E-05	9.5E-08
Background surface	4/4	2.3E-07 - 3.6E-06	NA

[a]2,3,7,8-TCDD equivalents in micrograms per gram.
[b]Number of samples in which the analyte was detected/total number of samples analyzed.
[c]Not applicable.

equivalent concentration of 1.9E-08 $\mu g/g$). Both of these concentrations were lower than the background range of 2,3,7,8-TCDD-equivalent concentrations (see Table 5-2 above).

For the second type of comparison, the concentrations of each of the congeners were converted into 2,3,7,8-TCDD equivalent concentrations using USEPA-recommended toxicity equivalency factors (TEFs), as described in Section 5.1.4.1.1. The 2,3,7,8-TCDD-equivalent detected concentrations were then summed to derive a total 2,3,7,8-TCDD-equivalent concentration for each sample. In the sample in which there were no dioxin/furan detections (OBP-95-01C), the detection limits for each congener were multiplied by the appropriate TEF. These values were averaged to derive a TCDD-equivalent detection limit for the sample; one-half of the TCDD-equivalent detection limit was used in the statistical calculations. The summary statistics for the dioxin/furan data are provided below.

The Student t-test was then used to compare the mean 2,3,7,8-TCDD-equivalent concentration in site surface and subsurface soil with the concentration in background surface soil. Data distribution was first tested using the Shapiro-Wilk test for normality (Gilbert 1987), which showed that all three data sets were lognormally distributed. The F test for equality of variances (Rosner 1986) showed that the variances of the log-transformed data were equal for site and background data. The t-test (for equal variances; Rosner 1986) demonstrated that the site mean concentrations of dioxins/furans in both surface and subsurface soils were not significantly higher than the background mean concentration (1-tailed test; $\alpha = 0.05$).

5.1.3.2 Summary of Analytical Results

The list of analytes detected in at least one surface or subsurface soil sample is provided in Table 5-3 for 1992 Phase I data and in Tables 5-4 and 5-5 for Phase II data. The complete data set is contained in Appendix H.

Table 5-3. *Summary of Analytes Detected in Soil for the Old Burn Area (SWMU 06) - Phase I*

Surface Soil

Group	Analytes	Background Concentrations	OBS-92-101 (0ft)	OBS-92-201 (0ft)	OBS-92-301 (0ft)	OBS-92-401 (0ft)	OBS-92-G01 (0ft)	OBS-92-G02 (0ft)	OBS-92-G03 (0ft)	OBS-92-G04 (0ft)	OBS-92-G05 (0ft)
METALS	BARIUM	247.1	130	380*	120	160	180	160	240	230	160
	CADMIUM	0.847	LT 0.424	10*	LT 0.424	LT 0.424	LT 0.424	LT 0.424	LT 0.424	LT 0.424	LT 0.424
	CHROMIUM	20.62	12.9	28.1*	16.7	12.3	17.1	10.5	11.8	13.6	12.4
	COPPER	24.72	33*	200*	13.9	27*	53*	30*	35*	62*	14.8
	IRON	22731	15000	39000*	15000	11000	20000	12000	10000	13000	16000
	LEAD	18.23	46*	12000*	16	22*	70*	35*	35*	43*	20*
	MERCURY	0.0572	0.25*	LT 0.0259	LT 0.0259	0.0279	0.0486	LT 0.0259	LT 0.0259	0.0277	LT 0.0259
	NICKEL	17.4	LT 2.46	8.82	LT 2.46	LT 2.46	LT 2.46	LT 2.46	LT 2.46	LT 2.46	LT 2.46
	SILVER	0.66	0.0853	1.2*	0.0612	0.0773	0.187	0.104	0.112	0.128	0.0818
	ZINC	102.8	130*	890*	43	190*	200*	280*	240*	240*	77
SEMIVOLATILES	2,4-DINITROTOLUENE	N/A	LT 0.39	LT 0.39	LT 0.39	0.75*	LT 0.39	10*	7*	4.5*	LT 0.39
	2,6-DINITROTOLUENE	N/A	LT 0.53	LT 0.53	LT 0.53	LT 0.53	LT 0.53	0.78*	0.58*	LT 0.53	LT 0.53
	BUTYLBENZYL PHTHALATE	N/A	ND 0.33	ND 0.33	0.283*	0.37#	0.18*	ND 0.33	0.29*	0.19*	0.31*
	DI-N-BUTYL PHTHALATE	N/A	ND 0.33	ND 0.33	ND 0.33	0.21*	ND 0.33	ND 0.33	ND 0.33	ND 0.33	ND 0.33
	N-NITROSO DIPHENYLAMINE	N/A	ND 0.33	ND 0.33	ND 0.33	0.051*	ND 0.33	ND 0.33	ND 0.33	ND 0.33	ND 0.33
ANIONS	NITRATE	N/A	6*	LT 3.36	LT 3.36	3.23#	11.4*	3.52*	3.17*	4.5*	2.76*
	PHOSPHATE	N/A	12.4*	ND 5	ND 5	8.74*	20.4*	11.8*	6.86*	8.73*	2.98*
EXPLOSIVES	2,4-DINITROTOLUENE	N/A	LT 0.744	LT 0.744	LT 0.744	LT 0.744	LT 0.744	1.73*	34*	3.64*	LT 0.744
	2,4,6-TRINITROTOLUENE	N/A	LT 0.931	LT 0.931	LT 0.931	LT 0.931	LT 0.931	LT 0.931	LT 0.931	3.4*	LT 0.931
	RDX	N/A	LT 0.445	LT 0.445	LT 0.445	LT 0.445	LT 0.445	8.36*	LT 0.445	LT 0.445	LT 0.445

Table 5-3. Summary of Analytes Detected in Soil for the Old Burn Area (SWMU 06) - Phase I (continued)

Subsurface Soil

Group	Analytes	Background Concentrations	OBP-92-101 (1ft)	OBP-92-101 (5ft)	OBP-92-102 (5ft)	OBP-92-103 (4ft)	OBP-92-104 (10ft)	OBP-92-201 (2ft)	OBP-92-202 (5ft)	OBP-92-203 (7.5ft)	OBP-92-204 (12ft)	OBP-92-301 (1ft)	OBP-92-301 (2.5ft)	OBP-92-302 (5ft)
METALS	ANTIMONY	15	NT	LT 68	LT 34	LT 34	LT 34	60.6*	LT 340	LT 340	LT 34	LT 34	NT	LT 34
	ARSENIC	11.69	NT	LT 24	LT 240	LT 24	LT 240	LT 24	95.2*	LT 24	LT 240	LT 48	NT	LT 240
	BARIUM	247.1	NT	180	56	120	62	310*	2300*	1700*	170	120	NT	68
	CHROMIUM	20.62	NT	26.5*	5.96	15.6	7.81	10.8	150*	220*	24.8*	14.1	NT	9.46
	COPPER	24.72	NT	110*	5.21	43*	9.7	110*	1700*	10000*	20	7.33	NT	3.59
	IRON	22731	NT	40000*	6500	24000*	14000	13000	290000*	110000*	29000*	13000	NT	9200
	LEAD	18.23	NT	580*	7	160*	12	11000*	3600*	17000*	28*	7.3	NT	5.5
	MERCURY	0.0572	NT	0.443*	0.0543	0.168*	0.0962*	0.0643*	LT 0.0259	LT 0.0259	LT 0.0259	LT 0.0259	NT	0.0776*
	NICKEL	17.4	NT	7.47	LT 2.46	LT 2.46	LT 2.46	LT 2.46	110*	48*	LT 2.46	LT 2.46	NT	LT 2.46
	SILVER	0.66	NT	0.156	0.0346	0.115	0.0376	0.77*	5*	12*	0.0778	0.0356	NT	0.043
	THALLIUM	11.7	NT	LT 170	LT 170	LT 170	LT 170	LT 170	347*	LT 170	LT 170	LT 170	NT	LT 170
	ZINC	102.8	NT	380*	22.8	1200*	150*	380*	11000*	7700*	75	35	NT	17.3
SEMIVOLATILES	2,4-DINITROTOLUENE	N/A	NT	LT 0.39	LT 0.39	LT 0.39	LT 0.39	LT 0.39	LT 0.39	LT 0.39	LT 0.39	LT 0.39	NT	LT 0.39
	BIS (2-ETHYHEXYL) PHTHALATE	N/A	NT	LT 0.39	LT 0.39	1.1*	LT 0.39	LT 0.39	LT 0.39	LT 0.39	LT 0.39	LT 0.39	NT	LT 0.39
	N-NITROSO DIPHENYLAMINE	N/A	NT	ND 0.33	ND 0.33	ND 0.33	ND 0.33	ND 0.33	ND 0.33	ND 0.33	ND 0.33	ND 0.33	NT	ND 0.33
ANIONS	CHLORIDE	N/A	NT	LT 39.6	LT 39.6	LT 39.6	LT 39.6	LT 39.6	31.7*	41.2*	LT 39.6	NT	LT 39.6	790*
	FLUORIDE	N/A	NT	LT 19.2	LT 19.2	LT 19.2	LT 19.2	LT 19.2	LT 19.2	LT 19.2	LT 19.2	NT	LT 19.2	12.4*
	NITRATE	N/A	NT	LT 3.36	LT 3.36	4.58*	LT 3.36	LT 3.36	LT 3.36	LT 3.36	9.47*	NT	2.49#	2.19#
	PHOSPHATE	N/A	NT	6.46*	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5	NT	ND 5	4.2*
	SULFATE	N/A	NT	LT 14.4	27.8#	49#	LT 14.4	121#	720*	580*	136*	NT	14#	900*
EXPLOSIVES	2,4-DINITROTOLUENE	N/A	NT	LT 0.744	LT 0.744	LT 0.744	LT 0.744	LT 0.744	LT 0.744	LT 0.744	LT 0.744	LT 0.744	NT	LT 0.744
	1,3,5-TRINITROBENZENE	N/A	NT	LT 0.352	LT 0.352	LT 0.352	LT 0.352	LT 0.352	LT 0.352	LT 0.352	LT 0.352	7.4*	NT	17*
	2,4,6-TRINITROTOLUENE	N/A	NT	LT 0.931	LT 0.931	LT 0.931	LT 0.931	LT 0.931	LT 0.931	LT 0.931	LT 0.931	8.52*	NT	16*

Table 5-3. *Summary of Analytes Detected in Soil for the Old Burn Area (SWMU 06) - Phase I (continued)*

			Subsurface Soil					
Group	Analytes	Background Concentrations	OBP-92-303 (7.5ft)	OBP-92-304 (10ft)	OBP-92-401 (2.5ft)	OBP-92-402 (5ft)	OBP-92-403 (7.5ft)	OBP-92-404 (9ft)
METALS	ANTIMONY	15	LT 34	LT 34	LT 34	LT 34	LT 34	LT 3.42
	ARSENIC	11.69	LT 240	LT 240	LT 72	LT 72	LT 24	LT 24
	BARIUM	247.1	190	130	100	98	33	38
	CHROMIUM	20.62	LT 39	LT 7.8	10.9	9.93	6.03	LT 3.9
	COPPER	24.72	LT 20	4.8	10.8	9.43	4.23	2.61
	IRON	22731	12000	8700	10000	11000	7300	2700
	LEAD	18.23	7.2	4.6	8.5	8.4	4.2	2.4
	MERCURY	0.0572	LT 0.0259	LT 0.0259	LT 0.0259	LT 0.0259	0.0302	LT 0.0259
	NICKEL	17.4	LT 25	LT 4.9	LT 2.46	LT 2.46	LT 2.46	LT 2.46
	SILVER	0.66	LT 0.0146	LT 0.0146	0.0405	0.0276	LT 0.0146	LT 0.0146
	THALLIUM	11.7	LT 1700	LT 1700	LT 50	LT 50	LT 170	LT 170
	ZINC	102.8	LT 80	LT 16	64	53	14.9	15.5
SEMIVOLATILES	2,4-DINITROTOLUENE	N/A	LT 0.39	LT 0.39	1.4*	LT 0.39	LT 0.39	LT 0.39
	BIS (2-ETHYHEXYL) PHTHALATE	N/A	LT 0.39	LT 0.39	LT 0.39	LT 0.39	LT 0.39	LT 0.39
	N-NITROSO DIPHENYLAMINE	N/A	ND 0.33	ND 0.33	6.1*	ND 0.33	ND 0.33	ND 0.33
ANIONS	CHLORIDE	N/A	1300*	860*	LT 39.6	LT 39.6	LT 39.6	LT 39.6
	FLUORIDE	N/A	LT 19.2	LT 19.2	LT 19.2	LT 19.2	LT 19.2	LT 19.2
	NITRATE	N/A	LT 3.36	3.33#	LT 3.36	2.44#	LT 3.36	LT 3.36
	PHOSPHATE	N/A	3*	ND 5	ND 5	ND 5	ND 5	ND 5
	SULFATE	N/A	1400*	820*	LT 14.4	LT 14.4	LT 14.4	LT 14.4
EXPLOSIVES	2,4-DINITROTOLUENE	N/A	LT 0.744	LT 0.744	LT 0.744	LT 0.744	25*	LT 0.744
	1,3,5-TRINITROBENZENE	N/A	LT 0.352	LT 0.352	LT 0.352	LT 0.352	LT 0.352	LT 0.352
	2,4,6-TRINITROTOLUENE	N/A	LT 0.931	LT 0.931	LT 0.931	LT 0.931	LT 0.931	LT 0.931

Note.- All values in µg/g (equal to ppm).
(D) = Duplicate analysis.
N/A = Not Applicable.
LT = Analyte concentration is less than CRL , the CRL is posted next to the "LT".
* = Organic analyte detected above CRL or MDL or detected inorganic analyte exceeding background.
ND = Analyte not detected above the MDL, the MDL is posted next to the "ND".
# = Analyte was detected in the associated blank in excess of the 5 or 10 times rule (as described in Section 3.1.1.1).
NT = Not Tested.

Table 5-4. Summary of Analytes Detected in Soil for the Old Burn Area (SWMU 06) - Phase II

Surface Soil

Group	Analytes	Background Concentrations	OBP-94-01A (0.5ft)	OBP-94-02A (0.5ft)	OBP-94-03A (0.5ft)	OBP-94-04A (0.5ft)	OBP-94-06A (0.5ft)	OBP-94-07A (0.5ft)	OBP-94-08A (0.5ft)	OBP-94-09A (0.5ft)	OBP-94-09A(D) (0.5ft)	OBP-94-10A (0.5ft)	OBP-94-12A (0.5ft)
METALS	ALUMINUM	28083	17300	12300	6730	14600	11500	16700	18400	18700	12100	9560	12600
	ANTIMONY	15	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6
	ARSENIC	11.69	7.17	2.68	3.34	3.93	3.6	6.51	3.53	3.97	5.08	34*	4.55
	BARIUM	247.1	344*	88	44.1	205	111	364*	179	158	131	167	113
	BERYLLIUM	1.455	0.726	0.549	LT 0.427	0.575	0.529	0.669	0.74	0.735	0.848	LT 0.427	0.647
	BORON	N/A	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	CADMIUM	0.847	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	1.59*	LT 1.2	LT 1.2	LT 1.2	1.38*	LT 1.2
	CALCIUM	114483	11800	2220	4460	4450	3650	30500	7070	12000	10400	4010	8210
	CHROMIUM	20.62	39.3*	14.8	9.41	34.4*	13.2	30.5*	20.6	20	12.9	26.1*	14
	COBALT	6.94	6	3.22	LT 2.5	6.62	3.46	5.49	4.66	5.99	5.98	6.64	4.72
	COPPER	24.72	112*	11.6	10.5	116*	17	347*	81.9*	16.8	16.7	38.7*	11.1
	IRON	22731	36500*	11500	7190	21600	12600	26100*	16400	16500	13100	26800*	12900
	LEAD	18.23	1800*	109*	32.2*	394*	20.8*	982*	55.9*	9.36	LT 7.44	89.4*	LT 7.44
	MAGNESIUM	7061	6960	3200	1560	4060	4340	5440	5860	6580	5590	3750	6000
	MANGANESE	698.3	488	208	93.9#	290	320	338	390	368	345	485	330
	MERCURY	0.0572	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	0.102*	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	23.3*	7.83	3.86	10.1	8.57	15.2	8.94	9.78	8.98	15.2	9.71
	POTASSIUM	5449	4820	3230	1720	4180	3470	4990	5610*	5750*	3620	3100	3650
	SODIUM	337	278	174	151	268	119	277	236	237	222	332	239
	VANADIUM	28.39	27.8	17.7	13.1#	21.9	15.9#	26.6	26.4	27.3	17.7	14.7	17.4
	ZINC	102.8	641*	43	45.9	137*	50.1	952*	177*	85.1	75.2	355*	41.1

Group	Analytes	Background Concentrations	OBS-94-01 (0.5ft)	OBS-94-02 (0.5ft)	OBS-94-03 (0.5ft)	OBS-94-04 (0.5ft)	OBS-94-05 (0.5ft)	OBS-94-06 (0.5ft)	OBS-94-07 (0.5ft)	OBS-94-08 (0.5ft)	OBS-94-09 (0.5ft)	OBS-94-09(D) (0.5ft)	OBS-94-10 (0.5ft)
METALS	ALUMINUM	28083	16500	18100	14200	15300	18100	11800	12600	11900	11300	8280	9380
	ANTIMONY	15	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6
	ARSENIC	11.69	4.81	5	4.77	3.61	5.13	5.41	5.14	4.17	3.5	4.01	3.55
	BARIUM	247.1	142	162	126	120	162	104	113	107	96.3	86.2	87.1
	BERYLLIUM	1.455	0.767	0.725	0.674	0.643	0.794	0.548	0.519	0.495	LT 0.427	LT 0.427	LT 0.427
	BORON	N/A	NT	NT	NT	NT	NT	14*	NT	NT	NT	NT	NT
	CADMIUM	0.847	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2
	CALCIUM	114483	4150	7330	5110	3720	4450	32000	3060	3060	2660	2520	2360
	CHROMIUM	20.62	17.4	16.5	15	17.5	17.4	13.9	12.3	12.5	14.1	9.15	11.1
	COBALT	6.94	5.32	5.32	4.88	3.83	5.27	3.08	4.17	4.49	4.05	2.9	3.86
	COPPER	24.72	17.5	18.6	13.6	14.4	18.1	15.5	15	20.2	24.1	18.2	9.61
	IRON	22731	15500	14600	13700	12500	16100	11200	11700	11100	9390	8800	9850
	LEAD	18.23	12.3	17.1	11	14.8	19.4*	14.7	16.7	22.3*	31.4*	23.2*	8.36
	MAGNESIUM	7061	7080*	7840*	6910	5770	7820*	9100*	4510	4430	3590	3240	3370
	MANGANESE	698.3	419	410	351	333	449	265	330	306	262	251	278
	MERCURY	0.0572	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	11.9	11.4	10.6	9.04	11.3	9.73	8.63	7.42	6.71	6.18	6.59
	POTASSIUM	5449	4670	4620	3940	4330	5120	3600	3350	3290	3180	2370	2510
	SODIUM	337	318	328	247	318	376*	247	264	250	256	178	161
	VANADIUM	28.39	21.9	20.5	19	20.9	23.1	16.5	16.6	15.5	15.4	10.5#	13.5
	ZINC	102.8	55.8	53.9	46	43.1	55.6	38.3	41.2	47.5	51.5	43.2	29.1

Table 5-4. Summary of Analytes Detected in Soil for the Old Burn Area (SWMU 06) - Phase II (continued)

Surface Soil

Group	Analytes	Background Concentrations	OBS-94-11 (0.5ft)	OBS-94-12 (0.5ft)	OBS-94-13 (0.5ft)	OBS-94-14 (0.5ft)	OBS-94-15 (0.5ft)	OBS-94-16 (0.5ft)	OBS-94-17 (0.5ft)	OBS-94-18 (0.5ft)	OBS-94-19 (0.5ft)	OBS-94-19(D) (0.5ft)	OBS-94-20 (0.5ft)
METALS	ALUMINUM	29083	14800	14800	LT 11.2	10200	7870	12100	10600	25000	11600	10600	15900
	ANTIMONY	15	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6
	ARSENIC	11.69	4.77	5.28	17.6*	4.66	10.2	3.17	5.03	9.05	5.52	5.33	4.34
	BARIUM	247.1	137	134	LT 3.29	83.2	87.8	93.8	86.2	247	166	152	119
	BERYLLIUM	1.455	0.665	0.606	LT 0.427	0.479	LT 0.427	LT 0.427	LT 0.427	1.09	0.513	0.479	0.642
	BORON	N/A	NT	NT	NT	NT	NT	NT	21.7*	NT	NT	NT	NT
	CADMIUM	0.847	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	1.8*	5.92*	6.98*	LT 1.2
	CALCIUM	114483	3060	3600	LT 25.3	2250	5350	2660	8090	16100	10300	8380	3230
	CHROMIUM	20.62	13.8	14.8	LT 1.04	9.37	9.42	12.7	14.6	23.2*	14.1	12.8	16.1
	COBALT	6.94	4.97	4.4	LT 2.5	3.83	2.73	3.4	4.23	7.75*	3.61	4.33	5.09
	COPPER	24.72	16.8	20.6	LT 2.84	20.3	16.4	12.5	23	76.9*	27.5*	29.2*	11.6
	IRON	22731	14200	13600	LT 6.66	11000	8270	10400	10000	22600	16200	13200	13600
	LEAD	18.23	12.2	23.2*	LT 7.44	21.3*	270*	11.7	106*	68.2*	35.5*	35.6*	LT 7.44
	MAGNESIUM	7061	5290	5110	LT 10.1	3510	3310	3950	3130	9870*	5750	5050	4970
	MANGANESE	698.3	351	365	LT 9.87	242	206	270	214	555	345	337	331
	MERCURY	0.0572	LT 0.05	LT 0.05	0.304*	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	0.187*	0.238*	LT 0.05
	NICKEL	17.4	10.4	9.34	LT 2.74	8.39	5.34	6.42	9.14	17	9.94	9.66	10.3
	POTASSIUM	5449	4010	3970	LT 131	2670	2250	3530	2420	7260*	3260	3030	4490
	SODIUM	337	251	347*	LT 38.7	110	156	211	210	314	279	234	259
	VANADIUM	28.39	18.6	20.5	LT 1.41	13.5	10.4#	15.5	19.5	30.3*	15.8	14.1	20.7
	ZINC	102.8	221*	59.7	10000*	44.3	75.6	35.9	123*	173*	144*	117*	49
		Background Concentrations	OBS-94-21 (0.5ft)	OBS-94-22 (0.5ft)	OBS-94-23 (0.5ft)	OBS-94-24 (0.5ft)	OBS-94-25 (0.5ft)	OBS-94-26 (0.5ft)	OBS-94-27 (0.5ft)	OBS-94-28 (0.5ft)	OBS-94-29 (0.5ft)	OBS-94-30 (0.5ft)	OBS-94-31 (0.5ft)
METALS	ALUMINUM	28083	9770	7710	7430	15600	15100	13200	11200	17700	16100	12000	14100
	ANTIMONY	15	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6
	ARSENIC	11.69	4.11	4.36	3.9	6.78	6.9	6.23	5.54	6.49	3.11	4.39	5.86
	BARIUM	247.1	121	106	796*	160	141	137	132	154	142	106	170
	BERYLLIUM	1.455	LT 0.427	LT 0.427	LT 0.427	0.775	0.691	0.576	0.615	0.819	LT 0.427	LT 0.427	LT 0.427
	BORON	N/A	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	CADMIUM	0.847	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	3.52*	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2
	CALCIUM	114483	5590	11800	2600	3630	3340	21600	6740	4120	4580	3170	5060
	CHROMIUM	20.62	11.6	8.99	8.6	14.9	14.4	14	12.1	17.2	22.8*	13.3	15.5
	COBALT	6.94	3.39	2.77	LT 2.5	5.8	5.62	4.16	4.95	6.24	5.61	4.53	5.07
	COPPER	24.72	22.7	16.1	139*	18.1	25.9*	23.4	40.8*	20.7	16.4	15.9	32.1*
	IRON	22731	10000	8730	8290	16000	14900	12300	13000	17100	16500	12700	14300
	LEAD	18.23	18.6*	13.4	44.1*	14	26.5*	36.4*	71*	16.5	33.8*	17.6	33.2*
	MAGNESIUM	7061	3600	3000	2920	6250	5090	5130	4660	6870	4940	3470	4290
	MANGANESE	698.3	271	212	228	422	413	310	334	448	471	312	394
	MERCURY	0.0572	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	7.27	7.28	5.81	11.4	10.8	9.08	9.56	12	9.41	7.28	8.4
	POTASSIUM	5449	2600	2130	2460	4820	4240	3830	3470	5080	4300	2800	3500
	SODIUM	337	170	161	148	241	219	207	207	265	461*	427*	497*
	VANADIUM	28.39	12.9	11.6	9.88#	17.8	17.6	18.1	15.1	21.3	22.2	16.4	19.2
	ZINC	102.8	286*	91.8	597*	97.6	97.9	61.2	102	56.7	61.7	48.2	170*

Table 5-4. Summary of Analytes Detected in Soil for the Old Burn Area (SWMU 06) - Phase II (continued)

			Surface Soil										
Group	Analytes	Background Concentrations	OBS-94-32 (0.5ft)	OBS-95-29 (0.5ft)	OBS-95-30 (0.5ft)	OBS-95-31 (0.5ft)	OBS-95-32 (0.5ft)	OBS-95-33 (0.5ft)	OBS-95-34 (0.5ft)	OBS-95-34(D) (0.5ft)	OBS-95-39 (0.5ft)	OBS-95-40 (0.5ft)	OBS-95-41 (0.5ft)
METALS	ALUMINUM	28083	18000	10200	13800	11600	7440	17800	13800	16400	9450	16700	14800
	ANTIMONY	16	LT 19.6	1.3	LT 1	LT 1	LT 1	LT 1	LT 1	LT 1	3.26	LT 1	1.25
	ARSENIC	11.69	3.87	6.86	4.58	4.98	4.54	8.75	7.22	6.27	5.57	6	5.9
	BARIUM	247.1	185	138	148	134	194	576*	196	196	163	181	213
	BERYLLIUM	1.455	LT 0.427	0.494	0.658	0.586	LT 0.427	0.943	0.76	0.804	0.551	0.813	0.702
	BORON	N/A	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	CADMIUM	0.847	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	1.39*	LT 1.2	LT 1.2	4.24*	LT 1.2	LT 1.2
	CALCIUM	114483	10300	2940	3080	3070	2660	8800	5800	5800	3510	5710	7970
	CHROMIUM	20.62	18.6	12.9	19.7	13.2	8.89	19.5	15.1	17.7	16.9	19.1	17.1
	COBALT	6.94	6.4	3.94	5.77	5.52	3.01	7.42*	6	6.05	3.79	5.98	5.37
	COPPER	24.72	20.6	78.4*	22.7	16.1	24.9*	56.6*	20.6	19.9	9900*	24.8*	33*
	IRON	22731	17700	11100	18100	14200	11200	20200	16500	18100	13000	17200	15500
	LEAD	18.23	23.2*	78.5*	27*	15.5	25.1*	60.4*	22.7*	21.2*	376*	31.7*	50.6*
	MAGNESIUM	7061	7860*	3340	4590	4290	3080	9750*	8620*	9060*	3520	7970*	7210*
	MANGANESE	698.3	505	340	402	379	309	673	648	649	320	578	477
	MERCURY	0.0572	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	10.7	7.27	10.6	10.2	7.04	13.6	11	12	10.5	11.2	11
	POTASSIUM	5449	5060	2810	3550	3250	2220	6000*	4990	5610*	2950	5260	4670
	SODIUM	337	654*	137	162	130	99.3	232	241	262	129	243	213
	VANADIUM	28.39	22.7	15.7	20.7	16.8	11.6	23.8	18.3	21.8	14.3	24.3	21
	ZINC	102.8	78.5	69.4	67.3	65.8	153*	408*	80.6	78	5700*	75.8	76.3

Table 5-4. Summary of Analytes Detected in Soil for the Old Burn Area (SWMU 06) - Phase II (continued)

Subsurface Soil

Group	Analytes	Background Concentrations	OBP-94-01B (2ft)	OBP-94-01C (5ft)	OBP-94-01D (7ft)	OBP-94-02B (2ft)	OBP-94-02C (5ft)	OBP-94-02D (7ft)	OBP-94-02E (10ft)	OBP-94-02F (3ft)	OBP-94-03B (2ft)	OBP-94-03C (5ft)	OBP-94-03D (7ft)
EXPLOSIVES	RDX	N/A	LT 1.28	9.41*	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28
METALS	ALUMINUM	28083	6580	3580#	4970#	2010#	1660#	28100*	6750	13600	1410#	2010#	2860#
	ARSENIC	11.69	9.19	3.14	3.03	LT 2.5	LT 2.5	2.99	3.13	4.29	LT 2.5	LT 2.5	LT 2.5
	BARIUM	247.1	65.2	142	151	13.5#	14.1#	141	79.8	99	8.69#	18.6#	20.3#
	BERYLLIUM	1.455	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	1.08	LT 0.427	0.548	LT 0.427	LT 0.427	LT 0.427
	CADMIUM	0.847	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2
	CALCIUM	114483	14200	120000*	100000	909#	15500	3940	100000	2740	857#	18800	5800
	CHROMIUM	20.62	11.7	6.05	8.16	3.78#	2.59#	26.3*	6.03#	16	3.85#	3.64#	4.71#
	COBALT	6.94	2.75	LT 2.5	LT 2.5	LT 2.5	LT 2.5	9.4*	LT 2.5	4.75	LT 2.5	LT 2.5	LT 2.5
	COPPER	24.72	6.46	7.77	9.31	LT 2.84	LT 2.84	13.3	5.17	10.6	LT 2.84	LT 2.84	3.54
	IRON	22731	10900	5330#	6660#	3170#	2590#	22000	6500	11800	2770#	3860#	4750#
	LEAD	18.23	LT 7.44	17.7	14.9	LT 7.44	LT 7.44	13	LT 7.44	19.1*	LT 7.44	10	19*
	MAGNESIUM	7061	2220	5120	5770	466#	551#	7870*	5410	3310	396#	1450	1000
	MANGANESE	698.3	111#	128	131	44.4#	35.2#	137	87.8#	239	33.3#	70.4#	64#
	MERCURY	0.0572	LT 0.05	0.0684*	0.0568	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	5.19	4.84	5.45	LT 2.74	LT 2.74	12.2	4.02	7.21	LT 2.74	LT 2.74	LT 2.74
	POTASSIUM	5449	1740	969#	1420#	475#	490#	7260*	1620	3610	457#	470#	705#
	SODIUM	337	160	273	315	60.1	51	573*	213	232	LT 38.7	103	252
	THALLIUM	11.7	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3
	VANADIUM	28.39	19.5	8.91#	11.8#	5.84#	7.2#	34.8*	10.3#	19.7	5.83#	7.26#	11.3#
	ZINC	102.8	21.3	31.9	39.6	7.41#	6.58#	48.5	16.6	48.1	4.03#	8.31#	12.3#

Group	Analytes	Background Concentrations	OBP-94-04B (2ft)	OBP-94-04C (5ft)	OBP-94-04D (7ft)	OBP-94-05C (5ft)	OBP-94-05D (7ft)	OBP-94-05E (10ft)	OBP-94-06B (2ft)	OBP-94-06C (5ft)	OBP-94-06D (7ft)	OBP-94-06E (10ft)	OBP-94-07B (2ft)
EXPLOSIVES	RDX	N/A	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28
METALS	ALUMINUM	28083	11500	8470	7830	8780	3860#	1220#	8920	2830#	4030#	1950#	13200
	ARSENIC	11.69	4.55	3.88	3.56	5.29	3.97	LT 2.5	3.36	3.85	3.51	LT 2.5	7.99
	BARIUM	247.1	103	59	68.7	57.7	31.4#	16.5#	89.7	61.1	76.8	22.2#	188
	BERYLLIUM	1.455	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	0.575
	CADMIUM	0.847	LT 1.2	LT 1.2	LT 1.2	46.5*	12.6*	3.98*	LT 1.2	LT 1.2	LT 1.2	LT 1.2	11*
	CALCIUM	114483	21000	16000	36300	11100	6840	20400	24600	37800	54800	27800	16700
	CHROMIUM	20.62	14.7	11.6	10.2	8.59	6.88	3.31#	10.5	5.2#	9.32	4.31#	23.2*
	COBALT	6.94	2.94	4.23	LT 2.5	LT 2.5	2.63	LT 2.5	3.45	LT 2.5	3.25	LT 2.5	5.29
	COPPER	24.72	16.6	10	5.59	2600*	311*	16.4	7.12	3.32	4.89	LT 2.84	85.3*
	IRON	22731	10100	9780	8340	8630	4560#	4860#	9830	4260#	6080#	2790#	42200*
	LEAD	18.23	25.9*	11.8	LT 7.44	30.7*	96.9*	18.3*	LT 7.44	LT 7.44	LT 7.44	LT 7.44	607*
	MAGNESIUM	7061	3430	5080	4690	1610	1050	2100	3840	4650	4670	1640	4840
	MANGANESE	698.3	190	167	108	142	74.4#	59#	192	64.7#	99.5#	44#	534
	MERCURY	0.0572	LT 0.05	LT 0.05	0.0578*	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	0.057	LT 0.05	0.259*
	NICKEL	17.4	7.15	7.95	4.5	6.01	3.36	LT 2.74	5.66	LT 2.74	4.36	LT 2.74	11.8
	POTASSIUM	5449	3060	2250	2380	1550	753#	402#	2330	833#	1160#	640#	3730
	SODIUM	337	257	205	314	89.5	60.5	LT 38.7	114	197	161	85.5	190
	THALLIUM	11.7	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3
	VANADIUM	28.39	21.8	17.1	15.8	13.1#	7.53#	4.63#	16.2#	9.26#	11.4#	5.39#	24
	ZINC	102.8	87	35.3	16.2	2300*	380*	55.9	29.5	10.2#	14.4#	6.84#	248*

Table 5-4. Summary of Analytes Detected in Soil for the Old Burn Area (SWMU 06) - Phase II (continued)

Subsurface Soil

Group	Analytes	Background Concentrations	OBP-94-07C (5ft)	OBP-94-07D (7ft)	OBP-94-07E (10ft)	OBP-94-08B (2ft)	OBP-94-08C (5ft)	OBP-94-08D (7ft)	OBP-94-08E (10ft)	OBP-94-09B (2ft)	OBP-94-09C (5ft)	OBP-94-09C(D) (5ft)	OBP-94-09D (7ft)
EXPLOSIVES	RDX	N/A	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28
METALS	ALUMINUM	28083	3830#	6270	4820#	20300	4470#	751#	2690#	18600	5500	4580	7760
	ARSENIC	11.69	3.31	3.99	7.09	6.62	2.68	LT 2.5	LT 2.5	4.51	4.72	4.6	4.27
	BARIUM	247.1	81.1	82.6	56.6	225	99.3	9.93#	31.7#	148	55.9	51.1	99.3
	BERYLLIUM	1.465	LT 0.427	LT 0.427	LT 0.427	0.87	LT 0.427	LT 0.427	LT 0.427	0.767	LT 0.427	LT 0.427	LT 0.427
	CADMIUM	0.847	LT 1.2	LT 1.2	LT 1.2	5.14*	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2
	CALCIUM	114483	38200	46700	35700	12200	61000	15900	17100	3940	23500	21700	22000
	CHROMIUM	20.62	7.52	10.1	8.04	20.6	7.69	2.15#	4.02#	20.6	8.1	7.58	9.2
	COBALT	6.94	LT 2.5	2.68	LT 2.5	5.21	3.16	LT 2.5	LT 2.5	4.2	2.79	2.96	3.37
	COPPER	24.72	30.5*	31.7*	19.1	22.1	4.37	LT 2.84	5.24	13.3	LT 2.84	4.7	17.3
	IRON	22731	7160#	8470	8220	20400	5790#	1850#	3990#	16900	7280	6570	9530
	LEAD	18.23	66.6*	96.4*	50.9*	25.6*	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	7.82
	MAGNESIUM	7061	3820	4700	4620	7730*	3790	943	1450	6180	2520	2230	4180
	MANGANESE	698.3	142	148	135	472	98.9#	30#	69.9#	387	110#	102#	227
	MERCURY	0.0572	0.173*	0.204*	LT 0.05	0.706*	0.0542	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	3.38	3.87	6.59	12.6	3.58	LT 2.74	LT 2.74	10.1	4.74	5.65	6.9
	POTASSIUM	5449	1200#	1890	1390#	5980*	1280#	269#	825#	5470*	1050	902	2080
	SODIUM	337	114	201	140	249	223	50.2	80.6	317	188	173	215
	THALLIUM	11.7	LT 34.3	LT 34.3	LT 34.3	46.7*	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3
	VANADIUM	28.39	10.7#	14.1#	12.7#	30.8*	11.2#	3.19#	6.67#	26.4	14#	12.4#	15
	ZINC	102.8	102	116*	94.3	137*	18.2#	4.7#	16.7#	53.1	18.6	16.1#	97.8

Table 5-4. *Summary of Analytes Detected in Soil for the Old Burn Area (SWMU 06) - Phase II (continued)*

Subsurface Soil

Group	Analytes	Background Concentrations	OBP-94-09E (10ft)	OBP-94-09E(D) (10ft)	OBP-94-10B (2ft)	OBP-94-10C (5ft)	OBP-94-10D (7ft)	OBP-94-10E (10ft)	OBP-94-12B (2ft)	OBP-94-12C (5ft)	OBP-94-12D (7ft)	OBP-94-12E (10ft)
EXPLOSIVES	RDX	N/A	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28
METALS	ALUMINUM	28083	3430#	3800#	6390	3830#	2570#	3000#	7660	16600	17200	6640
	ARSENIC	11.69	3.69	3.76	2.97	3.6	3.75	5.07	3.57	3.39	3.94	LT 2.5
	BARIUM	247.1	51.8	63.1	76.2	49.7	42.4	34.3#	77.7	165	145	74.2
	BERYLLIUM	1.465	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	0.726	0.602	LT 0.427
	CADMIUM	0.847	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2
	CALCIUM	114483	38500	34700	2230	7540	22800	12900	29200	93000	140000*	66000
	CHROMIUM	20.62	5.07	5.24	7.19	6.09	7.2	5.11	10.5	13.2	15.4	9.77
	COBALT	6.94	LT 2.5	3.11	4.02	LT 2.5	3.14	LT 2.5	3.76	5.91	5.54	3.35
	COPPER	24.72	LT 2.84	3.68	6.2	4.4	21.1	4.77	5.76	7.47	9.64	3.75
	IRON	22731	5970	6110	10500	6450	26400*	6740	9360	14800	15300	7110
	LEAD	18.23	LT 7.44	LT 7.44	LT 7.44	8.35	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44
	MAGNESIUM	7061	3830	3650	2710	1560	1400	2060	3630	14100*	13600*	6210
	MANGANESE	698.3	104#	107#	226	143	189	106#	184	182	297	132#
	MERCURY	0.0572	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	4.61	4.95	6.71	4.49	6.98	3.95	6.58	10.9	10.4	4.64
	POTASSIUM	5449	754#	779#	1770	876	562#	698#	1950	4740	4820	1610
	SODIUM	337	236	247	148	115	115	93	163	2300*	2310*	769*
	THALLIUM	11.7	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3
	VANADIUM	28.39	10.7#	11.2#	10.6#	10.7#	7.58#	12.6#	16.9	21.7	22.6	12.8#
	ZINC	102.8	16.6#	17.3#	45.2	23.1	24.1	12.6#	24.6	38.1	35.7	16.1#

Note.- All values in µg/g (equal to ppm).
N/A = Not Applicable.
LT = Analyte concentration is less than CRL , the CRL is posted next to the "LT".
* = Organic analyte detected above CRL or MDL or detected inorganic analyte exceeding background.
NT = Not Tested.
(D) = Duplicate analysis.
= Analyte was detected in the associated blank in excess of the 5 or 10 times rule (as described in Section 3.1.1.1).

Table 5-5. Summary of Dioxin/Furans Detected in Soil for the Old Burn Area (SWMU 06) - Phase II, 1995

Surface Soil

Group	Analytes		Background Concentrations	OBP-95-01A (0.5ft)	OBP-95-02A (0.5ft)	OBP-95-03A (0.5ft)	OBP-95-04A (0.5ft)	OBS-95-01 (0.5ft)	OBS-95-02 (0.5ft)	OBS-95-03 (0.5ft)	OBS-95-04 (0.5ft)
DIOXINS	678HPD	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	N/A	0.0000229*	LT 0.00000219	0.000356*	0.0000201*	LT 0.00000137	LT 0.00000312	0.00000346#	0.00000311#
	678HPF	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	N/A	0.0000315*	0.0000021#	0.0000544*	0.00000581*	0.00000325#	0.00000679#	0.00000587#	0.00000226#
	78HXDD	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	N/A	0.000000992*	LT 0.00000059	0.0000098*	LT 0.00000266	LT 0.00000308	LT 0.00000078	LT 0.00000082	LT 0.00000145
	78HXDF	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	N/A	0.00000603#	0.000000343*	0.0000165*	LT 0.00000102	LT 0.00000197	0.00000228#	LT 0.00000158	0.000000837#
	678HXD	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	N/A	LT 0.00000124	LT 0.00000048	0.0000287*	LT 0.00000216	LT 0.00000184	LT 0.00000046	LT 0.00000049	LT 0.00000087
	678HXF	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	N/A	0.00000163*	LT 0.00000037	0.00000675*	0.0000028*	LT 0.00000049	0.000000743*	0.000000636*	0.000000311*
	789HXD	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	N/A	0.00000231*	LT 0.00000053	0.0000398*	LT 0.00000092	LT 0.00000235	LT 0.00000059	LT 0.00000062	LT 0.00000111
	789HXF	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	N/A	0.00000194*	LT 0.00000057	LT 0.00000161	LT 0.00000142	LT 0.00000099	0.000000669*	LT 0.00000049	0.00000029*
	78PCDD	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	N/A	LT 0.0000006	LT 0.00000042	0.0000123*	LT 0.00000027	LT 0.00000075	LT 0.00000033	LT 0.0000003	LT 0.00000035
	78PCDF	1,2,3,7,8-PENTACHLORODIBENZOFURAN	N/A	0.00000123*	LT 0.00000049	0.00000615*	LT 0.00000032	LT 0.00000079	LT 0.00000029	LT 0.00000025	LT 0.00000034
	234HXF	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	N/A	0.00000792*	LT 0.00000033	0.0000114*	LT 0.00000042	LT 0.0000007	0.00000218*	0.00000154*	LT 0.00000035
	234PCF	2,3,4,7,8-PENTACHLORODIBENZOFURAN	N/A	LT 0.00000112	LT 0.00000053	0.0000126*	LT 0.00000033	LT 0.00000084	0.000000439*	LT 0.00000026	LT 0.00000036
	TCDD	2,3,7,8 TETRACHLORODIBENZODIOXIN	N/A	LT 0.00000069	LT 0.00000034	0.00000324*	LT 0.00000199	LT 0.00000107	LT 0.00000055	LT 0.00000027	LT 0.00000037
	TCDF	2,3,7,8 TETRACHLORODIBENZOFURAN	N/A	0.0000022*	LT 0.0000004	0.0000391*	0.00000136*	0.00000121*	0.000000732*	LT 0.00000045	LT 0.00000047
	OCDD	OCTACHLORODIBENZODIOXIN	N/A	0.000119*	0.0000106*	0.000931*	0.000127*	0.00000944#	0.0000195#	0.0000266#	0.000028#
	OCDF	OCTACHLORODIBENZOFURAN	N/A	0.000102*	LT 0.00000727	0.0000432*	0.0000183*	LT 0.00000502	0.0000124*	0.0000101*	0.00000476*
	789HPF	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	N/A	0.0000103*	LT 0.00000031	0.00000248*	LT 0.00000112	LT 0.00000129	0.00000118#	LT 0.0000016	LT 0.0000004
Totals											
	Dioxins			0.000145202	0.0000106	0.00138084	0.0001471	0	0	0	0
	Furans			0.00015872	0.000000343	0.00019258	0.00002575	0.00000121	0.000017163	0.000012276	0.000005361

Group	Analytes		Background Concentrations	OBS-95-05 (0.5ft)	OBS-95-06 (0.5ft)	OBS-95-07 (0.5ft)	OBS-95-08 (0.5ft)	OBS-95-09 (0.5ft)	OBS-95-10 (0.5ft)	OBS-95-10(D) (0.5ft)	OBS-95-11 (0.5ft)
DIOXINS	678HPD	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	N/A	0.00000437*	LT 0.0000009	0.00000225*	0.00000103*	0.00000131*	0.00000118*	LT 0.00000231	0.00000147*
	678HPF	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	N/A	0.00000248#	0.000000952#	0.00000288#	0.000000997#	0.00000158#	LT 0.00000088	0.00000513#	0.00000241#
	78HXDD	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	N/A	LT 0.00000033	LT 0.00000028	LT 0.00000032	LT 0.00000043	LT 0.00000026	LT 0.00000031	LT 0.00000049	LT 0.00000033
	78HXDF	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	N/A	0.000000424*	0.00000019*	LT 0.00000045	LT 0.0000001	0.000000386*	LT 0.0000002	0.00000103*	0.000000477*
	678HXD	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	N/A	LT 0.00000022	LT 0.00000019	LT 0.00000022	LT 0.00000029	LT 0.00000018	LT 0.00000021	LT 0.00000033	LT 0.00000022
	678HXF	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	N/A	LT 0.00000019	LT 0.00000012	0.000000268#	LT 0.00000008	0.000000154#	LT 0.00000008	LT 0.00000031	LT 0.00000026
	789HXD	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	N/A	LT 0.00000026	LT 0.00000022	LT 0.00000026	LT 0.00000034	LT 0.00000021	LT 0.00000025	LT 0.0000004	LT 0.00000027
	789HXF	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	N/A	LT 0.00000023	LT 0.00000021	LT 0.0000003	LT 0.00000015	LT 0.00000012	0.000000084*	LT 0.00000041	0.000000201*
	78PCDD	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	N/A	0.000000207*	LT 0.00000016	LT 0.00000023	LT 0.00000012	0.000000132*	LT 0.00000002	LT 0.00000014	LT 0.00000016
	78PCDF	1,2,3,7,8-PENTACHLORODIBENZOFURAN	N/A	0.000000174*	LT 0.00000014	LT 0.00000021	LT 0.00000032	LT 0.00000015	LT 0.00000013	LT 0.00000013	LT 0.00000015
	234HXF	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	N/A	LT 0.00000026	LT 0.00000015	LT 0.00000036	LT 0.00000011	0.000000209#	LT 0.00000014	LT 0.00000163	0.000000276#
	234PCF	2,3,4,7,8-PENTACHLORODIBENZOFURAN	N/A	LT 0.00000012	LT 0.00000015	0.000000182*	LT 0.00000034	0.00000011*	LT 0.00000014	0.000000636*	LT 0.00000009
	TCDD	2,3,7,8 TETRACHLORODIBENZODIOXIN	N/A	LT 0.00000023	LT 0.00000016	LT 0.00000008	LT 0.00000041	0.000000121*	LT 0.0000001	LT 0.00000016	LT 0.00000008
	TCDF	2,3,7,8 TETRACHLORODIBENZOFURAN	N/A	0.000000174#	0.000000127#	LT 0.0000002	0.000000206#	LT 0.00000018	0.000000169#	LT 0.00000026	0.000000233#
	OCDD	OCTACHLORODIBENZODIOXIN	N/A	0.0000539*	0.00000446#	0.0000164*	0.00000339#	0.00000622#	0.00000688#	0.0000166*	0.00000789#
	OCDF	OCTACHLORODIBENZOFURAN	N/A	0.00000665*	0.00000299#	0.00000676*	0.00000239#	0.00000363#	0.00000428#	0.0000165*	0.00000582#
	789HPF	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	N/A	0.000000337*	LT 0.00000046	0.000000557*	LT 0.0000002	LT 0.00000041	LT 0.00000022	0.00000146*	LT 0.00000032
Totals											
	Dioxins			0.000058477	0	0.00001865	0.00000103	0.000001563	0.00000118	0.0000166	0.00000147
	Furans			0.000007585	0.00000019	0.000007499	0	0.000000496	0.000000084	0.000019626	0.000000678

Table 5-5. Summary of Dioxin/Furans Detected in Soil for the Old Burn Area (SWMU 06) - Phase II, 1995 (continued)

Surface Soil

Group		Analytes	Background Concentrations	OBS-95-12 (0.5ft)	OBS-95-13 (0.5ft)	OBS-95-14 (0.5ft)	OBS-95-15 (0.5ft)	OBS-95-16 (0.5ft)	OBS-95-17 (0.5ft)	OBS-95-18 (0.5ft)	OBS-95-19 (0.5ft)
DIOXINS	678HPD	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	N/A	0.0000139*	0.0000608*	0.000131*	0.00000407*	0.00000523*	0.000113*	0.0000271*	0.0000542*
	678HPF	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	N/A	0.00000546#	0.0000134*	0.0000409*	0.00000121#	0.00000289#	0.0000307*	0.0000419#	0.0000919*
	78HXDD	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	N/A	0.000000172*	0.00000144*	0.00000201*	LT 0.00000053	LT 0.00000016	0.00000303*	0.00000119*	LT 0.0000097
	78HXDF	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	N/A	0.00000058*	0.000000843*	0.00000337*	0.000000193*	LT 0.00000058	0.00000834*	0.00000151*	0.00000267*
	678HXD	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	N/A	0.000000451*	0.00000324*	0.00000462*	LT 0.00000036	LT 0.0000004	0.000007*	0.00000334*	0.00000302*
	678HXF	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	N/A	0.000000301#	0.000000573#	0.00000215*	LT 0.0000008	LT 0.00000021	0.00000415*	0.000000778*	0.00000106*
	789HXD	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	N/A	LT 0.00000033	0.00000466*	0.00000421*	LT 0.00000043	LT 0.00000038	0.0000101*	0.00000439*	0.00000378*
	789HXF	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	N/A	0.000000129*	0.000000162*	0.000000879*	LT 0.00000014	LT 0.00000012	0.000000842*	LT 0.00000043	LT 0.00000035
	78PCDD	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	N/A	LT 0.00000026	LT 0.00000136	0.000000956*	0.000000289*	0.000000238*	0.00000267*	0.00000162*	0.00000109*
	78PCDF	1,2,3,7,8-PENTACHLORODIBENZOFURAN	N/A	LT 0.00000022	LT 0.00000052	0.000000868*	0.000000139*	LT 0.00000014	0.00000229*	0.000000736*	0.00000108*
	234HXF	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	N/A	LT 0.00000035	0.000000616#	0.00000196*	LT 0.00000001	LT 0.00000026	0.00000568*	LT 0.0000092	LT 0.00000129
	234PCF	2,3,4,7,8-PENTACHLORODIBENZOFURAN	N/A	LT 0.00000013	0.0000013*	0.00000067*	LT 0.00000012	LT 0.00000019	0.00000336*	0.00000102*	0.00000161*
	TCDD	2,3,7,8 TETRACHLORODIBENZODIOXIN	N/A	LT 0.00000011	0.000000346*	LT 0.0000002	LT 0.00000007	LT 0.0000001	0.00000068*	LT 0.0000083	LT 0.00000038
	TCDF	2,3,7,8 TETRACHLORODIBENZOFURAN	N/A	0.000000279#	LT 0.00000041	0.00000122*	0.000000171#	0.000000346#	0.00000693*	0.00000336*	0.00000638*
	OCDD	OCTACHLORODIBENZODIOXIN	N/A	0.000141*	0.000558*	0.00112*	0.0000225*	0.0000411*	0.000391*	0.0000672*	0.000317*
	OCDF	OCTACHLORODIBENZOFURAN	N/A	0.0000117*	0.0000214*	0.00014*	0.00000305#	0.00000582#	0.000016*	LT 0.00000381	0.0000119*
	789HPF	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	N/A	LT 0.00000049	0.00000093*	0.00000392*	LT 0.00000019	0.000000432*	0.00000136*	LT 0.0000053	0.000000751*
Totals											
	Dioxins			0.000155523	0.000628486	0.001262796	0.000026859	0.000046568	0.00052748	0.00010484	0.00037909
	Furans			0.000012409	0.000036865	0.000195937	0.000000332	0.000000432	0.000079652	0.000007404	0.000034641

Group		Analytes	Background Concentrations	OBS-95-20 (0.5ft)	OBS-95-20(D) (0.5ft)	OBS-95-21 (0.5ft)	OBS-95-22 (0.5ft)	OBS-95-23 (0.5ft)	OBS-95-24 (0.5ft)	OBS-95-25 (0.5ft)	OBS-95-26 (0.5ft)
DIOXINS	678HPD	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	N/A	0.00000527*	0.00000563*	0.0000075#	0.0000831*	0.0000186*	0.00000332#	0.0000493#	0.0000161*
	678HPF	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	N/A	0.00000198#	0.00000181#	0.0000189#	0.0000285*	0.0000172#	0.00000546#	0.0000811#	0.0000353*
	78HXDD	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	N/A	LT 0.0000004	LT 0.00000035	LT 0.00000062	0.00000148*	LT 0.00000045	LT 0.00000059	LT 0.0000096	0.00000069*
	78HXDF	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	N/A	LT 0.00000053	0.000000506*	0.00000448#	0.00000654#	0.00000409#	0.00000193#	0.00000306#	0.0000108#
	678HXD	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	N/A	LT 0.00000043	LT 0.00000065	0.000000492*	0.00000407*	0.000000964*	LT 0.00000035	LT 0.0000057	0.00000104*
	678HXF	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	N/A	LT 0.00000036	0.000000196#	LT 0.00000132	0.00000179*	LT 0.00000105	0.000000473*	0.000000868*	0.00000334*
	789HXD	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	N/A	LT 0.00000043	LT 0.00000035	0.00000061*	0.00000565*	0.0000014*	LT 0.00000045	LT 0.0000073	LT 0.00000196
	789HXF	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	N/A	LT 0.00000019	LT 0.0000001	0.00000172*	0.0000015*	0.00000104*	0.000000442*	LT 0.0000045	LT 0.00000194
	78PCDD	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	N/A	LT 0.0000003	0.00000031*	LT 0.00000026	0.00000129*	LT 0.00000034	LT 0.00000027	0.000000466*	0.000000648*
	78PCDF	1,2,3,7,8-PENTACHLORODIBENZOFURAN	N/A	0.000000349*	LT 0.00000024	LT 0.00000046	0.00000479*	0.00000072*	LT 0.00000027	LT 0.0000049	0.00000201*
	234HXF	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	N/A	0.000000473#	LT 0.00000028	0.0000058*	0.00000542*	0.00000478*	LT 0.00000108	LT 0.00000142	0.00000752*
	234PCF	2,3,4,7,8-PENTACHLORODIBENZOFURAN	N/A	0.000000349*	LT 0.00000035	0.000000642*	0.00000217*	LT 0.00000051	LT 0.00000037	LT 0.0000007	0.00000231*
	TCDD	2,3,7,8 TETRACHLORODIBENZODIOXIN	N/A	0.000000144*	LT 0.00000026	0.000000203*	LT 0.00000034	LT 0.00000019	LT 0.00000032	LT 0.00000026	LT 0.00000063
	TCDF	2,3,7,8 TETRACHLORODIBENZOFURAN	N/A	LT 0.00000064	0.000000619#	0.00000191*	0.00000683*	0.00000128*	0.00000123*	0.00000229*	0.00000509*
	OCDD	OCTACHLORODIBENZODIOXIN	N/A	0.0000379*	0.0000366*	0.0000575#	0.000604*	0.000131*	0.0000205#	0.000039#	0.000129*
	OCDF	OCTACHLORODIBENZOFURAN	N/A	0.00000353#	0.0000038#	0.0000999*	0.0000663*	0.0000439*	0.0000121*	0.000014*	0.000123*
	789HPF	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	N/A	LT 0.00000021	LT 0.00000025	LT 0.00000609	0.00000541*	0.00000414*	LT 0.00000094	0.00000899#	0.00000726*
Totals											
	Dioxins			0.000043314	0.00004254	0.000001305	0.00069959	0.000151964	0	0.000000466	0.000147478
	Furans			0.000000698	0.000000506	0.000109972	0.00012271	0.00005586	0.000014245	0.000017158	0.00018583

Table 5-5. Summary of Dioxin/Furans Detected in Soil for the Old Burn Area (SWMU 06) - Phase II, 1995 (continued)

Surface Soil

Group	Analytes		Background Concentrations	OBS-95-27 (0.5ft)	OBS-95-28 (0.5ft)	OBS-95-28(D) (0.5ft)
DIOXINS	678HPD	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	N/A	LT 0.00000334	0.000017*	0.0000167*
	678HPF	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	N/A	0.00000286#	0.000011#	0.00000791#
	78HXDD	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	N/A	LT 0.00000628	LT 0.00000096	LT 0.00000276
	78HXDF	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	N/A	LT 0.00000041	0.00000337#	LT 0.00000155
	678HXD	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	N/A	LT 0.00000374	0.000000863*	LT 0.00000165
	678HXF	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	N/A	LT 0.00000028	0.000000956*	LT 0.0000006
	789HXD	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	N/A	LT 0.0000048	LT 0.00000079	LT 0.00000211
	789HXF	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	N/A	LT 0.00000057	LT 0.00000099	LT 0.00000119
	78PCDD	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	N/A	LT 0.00000056	LT 0.00000035	LT 0.00000087
	78PCDF	1,2,3,7,8-PENTACHLORODIBENZOFURAN	N/A	LT 0.0000009	0.000000696*	0.00000083*
	234HXF	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	N/A	LT 0.0000004	0.00000315*	LT 0.00000085
	234PCF	2,3,4,7,8-PENTACHLORODIBENZOFURAN	N/A	LT 0.00000094	0.000000499*	LT 0.00000086
	TCDD	2,3,7,8 TETRACHLORODIBENZODIOXIN	N/A	LT 0.00000057	0.000000374*	LT 0.000001
	TCDF	2,3,7,8 TETRACHLORODIBENZOFURAN	N/A	0.000000759*	0.00000104*	LT 0.00000145
	OCDD	OCTACHLORODIBENZODIOXIN	N/A	0.0000206#	0.00016*	0.000146*
	OCDF	OCTACHLORODIBENZOFURAN	N/A	0.00000935*	0.0000182*	0.0000154*
	789HPF	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	N/A	LT 0.0000011	0.00000249#	0.00000153#
Totals						
	Dioxins			0	0.000178237	0.0001627
	Furans			0.000010109	0.000024541	0.00001623

Subsurface Soil

Group	Analytes		Background Concentrations	OBP-95-01B (2ft)	OBP-95-01C (4ft)	OBP-95-02B (5ft)	OBP-95-02C (7ft)	OBP-95-02C(D) (7ft)	OBP-95-03B (1.5ft)	OBP-95-03C (4ft)	OBP-95-04B (1ft)
DIOXINS	678HPD	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	N/A	0.00024*	LT 0.00000306	0.000349*	0.00019*	0.00000456*	0.000554*	0.0000145*	0.0000382*
	678HPF	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	N/A	0.00000969*	LT 0.00000152	0.0000367*	0.00000757*	0.00000131#	0.0000973*	0.00000239#	0.0000126*
	78HXDD	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	N/A	0.000004*	LT 0.00000105	0.0000141*	LT 0.00000845	LT 0.00000134	0.0000141*	LT 0.00000068	LT 0.00000116
	78HXDF	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	N/A	0.00000105*	LT 0.00000066	0.0000218*	0.00000226*	LT 0.00000053	0.0000396*	LT 0.00000064	0.00000501*
	678HXD	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	N/A	0.0000125*	LT 0.00000086	0.0000277*	0.0000171*	0.000000451*	0.0000531*	0.00000137*	LT 0.00000279
	678HXF	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	N/A	0.000000552*	LT 0.00000068	0.00000892*	0.000000762*	LT 0.00000047	0.0000164*	LT 0.00000062	LT 0.0000023
	789HXD	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	N/A	0.0000161*	LT 0.00000095	0.000052*	0.0000324*	LT 0.0000012	0.0000683*	0.0000018*	0.00000355*
	789HXF	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	N/A	LT 0.0000003	LT 0.00000081	LT 0.00000317	LT 0.00000048	LT 0.00000074	0.00000582*	0.000000192*	LT 0.00000067
	78PCDD	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	N/A	0.00000426*	LT 0.0000012	0.0000144*	0.0000101*	LT 0.00000091	0.0000199*	LT 0.0000008	0.00000152*
	78PCDF	1,2,3,7,8-PENTACHLORODIBENZOFURAN	N/A	0.000000388*	LT 0.0000009	0.00000705*	LT 0.0000007	LT 0.00000042	0.0000192*	0.000000364*	0.00000137*
	234HXF	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	N/A	0.00000114*	LT 0.0000007	0.0000136*	0.00000156*	0.000000311*	0.0000237*	0.000000475*	LT 0.00000232
	234PCF	2,3,4,7,8-PENTACHLORODIBENZOFURAN	N/A	0.000000501*	LT 0.00000098	0.0000107*	LT 0.00000106	LT 0.00000046	0.0000281*	0.000000444*	0.0000022*
	TCDD	2,3,7,8 TETRACHLORODIBENZODIOXIN	N/A	0.000000848*	LT 0.00000131	0.00000251*	LT 0.00000175	LT 0.00000046	0.00000602*	LT 0.00000103	LT 0.00000022
	TCDF	2,3,7,8 TETRACHLORODIBENZOFURAN	N/A	0.00000146*	LT 0.00000133	0.0000272*	0.00000223*	0.000000421*	0.0000988*	0.00000203*	0.00000477*
	OCDD	OCTACHLORODIBENZODIOXIN	N/A	0.00077*	LT 0.00000604	0.000711*	0.000367*	0.000012*	0.00141*	0.0000417*	0.000164*
	OCDF	OCTACHLORODIBENZOFURAN	N/A	0.0000134*	LT 0.00000562	0.0000334*	0.0000136*	LT 0.00000594	0.0000651*	LT 0.00000587	0.000017*
	789HPF	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	N/A	LT 0.00000104	LT 0.00000086	0.00000503*	LT 0.00000121	LT 0.00000031	0.00000599*	LT 0.00000075	LT 0.00000194
Totals											
	Dioxins			0.001047708	0	0.00117071	0.0006166	0.000017011	0.00212542	0.00005937	0.00020727
	Furans			0.000028181	0	0.0001644	0.000027982	0.000000732	0.00040001	0.000003505	0.00004295

Table 5-5. *Summary of Dioxin/Furans Detected in Soil for the Old Burn Area (SWMU 06) - Phase II, 1995 (continued)*

Subsurface Soil

Group	Analytes		Background Concentrations	OBP-95-04C (2.5ft)
DIOXINS	678HPD	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	N/A	0.00000209*
	678HPF	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	N/A	LT 0.000001
	78HXDD	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	N/A	LT 0.00000038
	78HXDF	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	N/A	LT 0.00000031
	678HXD	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	N/A	LT 0.00000031
	678HXF	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	N/A	LT 0.00000028
	789HXD	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	N/A	LT 0.00000034
	789HXF	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	N/A	LT 0.00000043
	78PCDD	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	N/A	LT 0.00000068
	78PCDF	1,2,3,7,8-PENTACHLORODIBENZOFURAN	N/A	LT 0.0000003
	234HXF	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	N/A	LT 0.00000034
	234PCF	2,3,4,7,8-PENTACHLORODIBENZOFURAN	N/A	LT 0.00000033
	TCDD	2,3,7,8 TETRACHLORODIBENZODIOXIN	N/A	LT 0.00000079
	TCDF	2,3,7,8 TETRACHLORODIBENZOFURAN	N/A	0.000000451*
	OCDD	OCTACHLORODIBENZODIOXIN	N/A	0.00000929*
	OCDF	OCTACHLORODIBENZOFURAN	N/A	0.0000033*
	789HPF	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	N/A	LT 0.00000039
Totals				
	Dioxins			0.00001138
	Furans			0.000003751

Note.- All values in $\mu g/g$ (equal to ppm).
N/A = Not Applicable.
* = Organic analyte detected above CRL or MDL or detected inorganic analyte exceeding background.
# = Analyte was detected in the associated blank in excess of the 5 or 10 times rule (as described in Section 3.1.1.1).
LT = Analyte concentration is less than CRL, the CRL is posted next to the "LT".
(D) = Duplicate analysis.

5.1.3.3 *Nature and Extent of Contamination*

5.1.3.3.1 ***Phase I Results.*** One test pit excavated during Phase I of the RI (Test Pit No.2) was located within the revetment area of the SWMU where several trenches were shown in historical photographs and verified by the geophysical survey. A variety of munitions-related debris was encountered in this test pit. Sampled soil contained very high levels of a variety of metals (see Figure 5-1).

The surface samples contained silver (1.2 μg/g), barium (380 μg/g), cadmium (10 μg/g), chromium (28.1 μg/g), iron (39,000 μg/g), lead (12,000μg/g), and zinc (880 μg/g) in concentrations above background threshold values down to a depth of 7.5 feet. Lead concentrations above background in subsurface soil ranged from 3,600 to 17,000 μg/g. Subsurface soil at varying depths contained elevated concentrations of nickel, mercury, antimony, arsenic, thallium, and nitrate. The only metals detected above background at a depth of 12 feet were chromium and iron. Nitrate was also detected above background at a depth of 12 feet. Test Pit No. 1, located just northwest of the revetment, was found to contain metal banding left over from the burning of boxes and crates in the area. Soil samples collected from this test pit also contained elevated concentrations of several metals, including mercury, copper, zinc, iron, lead, and chromium. Test Pit No. 3, to the south of the revetment, contained 1,3,5-trinitrobenzene and 2,4,6-trinitrotoluene at depths of 1 foot and 5 feet. Mercury (0.078 μg/g) and fluoride (12.4 μg/g) were the only metals detected above background threshold values, both at a depth of 5 feet. Test Pit No. 4, which was located in a disturbed area that was identified visually rather than by geophysical methods, contained low concentrations of 2,4-dinitrotoluene in the samples collected at surface, 2.5 feet, and 7.5 feet.

The surface soil sample and the sample from 2.5 feet also contained low concentrations of N-nitrosodiphenylamine. None of the contamination appeared to be widespread or in significant concentrations. Copper (27 μg/g), zinc (190 μg/g), and lead (22 μg/g) were detected at slightly above background threshold values and only in surface soil. Di-n-butyl phthalate was detected at a low concentration in the surface sample.

Several shallow drainage areas (gullies) were also sampled on the northern side of the SWMU during the Phase I RI field activities to determine if contaminants are migrating off site via the surface-water pathway (see Figure 5-1). These drainages were found to be intercepted by a manmade drainage ditch, which carries runoff to the northwestern corner of the SWMU where the ditch exits via a culvert under the access road. Nearly all of the gully soil/sediment samples contained explosive contaminants and elevated concentrations of metals. A sample taken in the ditch where it exits the SWMU contained lead (20.0 μg/g), butylbenzyl phthalate (0.31 μg/g), and traces of phosphate and nitrate anions. It is not known exactly when the manmade interceptor ditch was constructed. EPIC photographs of the SWMU indicate that it was not present in 1953, but was present by October 1959. The burning ground and test area are visible in the 1953 photograph.

5.1.3.3.2 ***Phase II Results.*** The geophysical anomalies that were identified at SWMU 6 during the Phase I RI were relocated with an EM31 terrain conductivity meter to establish the Phase II RI sampling locations. Two geophysical anomalies were located within the revetment area of SWMU 6 (see Figure 5-1). These anomalies were separated by a raised area extending north-south between the anomalies. Five test pits and two observation pits were excavated in this revetment area during the Phase II RI field activities (see Figure 5-2).

Located on the north end of the larger geophysical anomaly in the revetment area, test pit OBP-94-01 was excavated to 7 feet with samples collected at the surface (0.5 foot), 2 feet, 5 feet, and 7 feet. The surface sample (OBP-94-01A) was found to contain concentrations of barium (344 μg/g), chromium (39.3 μg/g), copper (112 μg/g), nickel (23.3 μg/g), lead (1,800 μg/g), and zinc (641 μg/g) that exceeded their corresponding background soil concentrations.

Metal debris (e.g., nails, hinges, steel straps), wood, and cement were scattered in with the soil from the surface to about 2 feet in this test pit (see Appendix B). At 2 feet, a natural deposit of calcium carbonate-cemented gravel was encountered. No contaminants were detected in the 2-foot sample (OBP-94-01B). The sample collected at 5 feet (OBP-94-01C) was the only Phase II sample at SWMU 6 that contained explosive contamination (RDX at 9.41 μg/g). Mercury was also detected above the background level in the 5-foot sample at 0.0684 μg/g. In the 7-foot sample (OBP-94-01D), no contaminants were detected above background concentrations.

Test pit OBP-94-02 was excavated at the southern end of the same geophysical anomaly in which test pits OBP-94-01 and the Phase I Test Pit No. 2 are located. In the surface sample, lead was detected at a concentration of 109 μg/g and was the only metal that exceeded its respective background concentration of 18.2 μg/g (OBP-94-02A). A horizon with burned metal debris was found from 1 foot at the western edge of the pit, sloping to 4 feet bgs half-way across test pit OBP-94-02 (Appendix B) to the east. Fill material comprised of a mixture of silt, sand, and gravels covered this burn horizon. The subsurface samples collected at 2 feet (OBP-94-02B) did not contain metals contamination. The 3-foot sample (OBP-94-02F) collected in the burn horizon was found to contain lead at a concentration of 19.1 μg/g. The sample collected at 5 feet (OBP-94-02C) did not contain contamination. The 7-foot sample (OBP-94-02D), however, had elevated levels of aluminum (28,100 μg/g), magnesium (7,870 μg/g), potassium (7,260 μg/g), sodium (573 μg/g), cobalt (9.4 μg/g), chromium (26.3 μg/g), and vanadium 34.8 μg/g). Sample OBP-94-02E, collected at 10 feet, contained no contaminants above background levels (Figure 5-2).

Test pit OBP-94-03 was excavated on the eastern side of the center raised area; this test pit, however, was not located over a geophysical anomaly (see Figure 5-1). Below the half foot of disturbed surface soil, the rest of the material was assessed to be undisturbed sediment. Elevated lead contamination was detected in the surface sample at a concentration of 32.2 μg/g and at a concentration of 19 μg/g at the 7-foot sample (see Figure 5-2).

Test pit OBP-94-04, located over the geophysical anomaly on the northeastern side of the raised area, had metal debris scattered across the surface (see Figure 5-2). A buried trench that was filled with miscellaneous metal and glass debris was encountered at depths ranging from the surface to 3 feet bgs. Contamination in this test pit was detected in the surface soil

sample where chromium (34.4 μg/g), copper (116 μg/g), lead (394 μg/g), and zinc (137 μg/g) all exceeded the background metals concentrations. Lead exceeded background in the 2-foot sample at 25.9 μg/g but was not detected below 2 feet. No elevated metals were detected in the 5-foot sample. However, in the sample collected at 7 feet, mercury was detected above background at 0.0578 μg/g.

To determine if any trenching activities had occurred in the center raised area, two observation pits were excavated perpendicular to this feature. Observation Pit No. 01 cut across the north end of the raised area from east to west. This trench was 42 feet long, 2 feet wide, and was excavated to a nominal depth of 8 feet. A 26-foot-long, buried trench was exposed on the western half of this raised feature from 0.5 to 3 feet bgs. Burned metal banding and wood debris, glass, and concrete blocks were all exposed within the main dumping area of the trench (see Appendix B). No soil samples were collected from Observation Pit No. 01; instead, samples were collected from OBP-94-05 to characterize this contamination.

Observation Pit No. 02 was excavated across the southern end of the raised feature. This test pit was 82 feet long with a maximum depth of 10 feet. Burned metal debris, including several 55-gallon drums, small ammunition boxes, smoke grenades, smoke pots, and wood debris, was uncovered within this test pit (see Appendix B). The debris pile was encountered in a silty fill material, ranging in depth from 4 feet to 5 feet bgs; directly below the debris, sediments exhibiting natural bedding characteristics were present. Samples were collected at the eastern end of the pit (designated OBP-94-05) at 5, 7, and 10 feet (Appendix B). This test pit was added to the 10 proposed test pits at SWMU 6 because this disturbed area warranted characterization. Cadmium, copper, lead, and zinc were detected in both the 5-foot sample and 7-foot sample (OBP-94-05C and OBP-94-05D) at levels exceeding the background concentrations (with the highest concentration of copper at 2,600 μg/g). At 10 feet, two metals, cadmium (3.98 μg/g) and lead (18.3 μg/g), were detected above their respective background concentrations. The concentrations of the metals in this test pit decreased rapidly with depth. The cadmium concentration, for example, decreased from 46.5 μg/g at 5 feet, to 12.6 μg/g at 7 feet, and to 3.98 μg/g at 10 feet.

Test pit OBP-94-06 was excavated over a geophysical anomaly west of the revetments (see Figure 5-2). No surface or subsurface debris was encountered in this pit. Lead, at 20.8 μg/g detected in OBP-94-06A, was the only contaminant found at this location.

One surface sample (OBS-94-17) collected from the revetment area was found to contain elevated levels of lead (106 μg/g) and zinc (123 μg/g) (see Figure 5-3).

In summary, the revetment area appears to be contaminated by a variety of metals and one explosive as a result of burning activities in the trenches. The horizontal extent of contamination was not clearly delineated, but it appears to be limited to the areas corresponding with geophysical anomalies and the raised area between the anomalies. The eastern part of the revetment area seemed undisturbed, and the one surface sample collected just east of the revetment area (OBS-94-16) did not contain any metals exceeding background

concentrations. The analytical results from the test pits within the revetment suggest that some vertical migration of metals has occurred. The vertical extent of migration was only defined in test pits OBP-94-01 (above 7 feet), OBP-94-02 (above 10 feet), and OBP-94-03 (above 10 feet).

The remaining six test pits at SWMU 6 were excavated in conjunction with unevaluated Phase I RI geophysical anomalies located outside of the revetment area. Debris was encountered in test pits OBP-94-07, -08, and -09 (see Figure 5-2). In addition to metal debris encountered in Test Pit OBP-94-07, primers, igniters, flares, bullets, and cartridge cases were also found. A total of 30 surface soil samples were also collected outside the revetment area during the Phase II RI field activities. Twelve of these samples contained elevated concentrations of various metals, including barium, cadmium, cobalt, copper, chromium, lead, mercury, vanadium, and zinc (see Figure 5-2). No explosives were detected in any of these samples.

Three of the surface samples collected north of the Old Burn Area boundary during Phase II RI field activities—OBS-94-29, OBS-94-31, and OBS-94-32—contained elevated metals concentrations (with the maximum concentration of zinc at 170 $\mu g/g$). The horizontal extent of contamination to the north was not defined. It appears that not all of the runoff in the drainages is intercepted by the manmade ditch to the north or that off-site migration may have occurred before the interceptor ditch was installed, as sample OBS-94-29 was collected in one of the ditches north of the interception ditch.

Test pits OBP-94-07 and -08 were excavated at opposite ends of a linear depression located west of OBP-94-06 (see Figure 5-2). Large amounts of metal debris were piled on the surface in this depression. Burned metal debris—consisting of bullets, banding, primers, igniters, cartridge cases, a car seat, flares, boosters, and fuses—was uncovered in both test pits (see Appendix B). The surface soil samples of OBP-94-07 and OBP-94-08 contained several metals that exceeded their background concentration levels, including barium (364 in OBP-94-07), cadmium (1.59 in OBP-94-07), chromium (30.5 in OBP-94-07), copper (347 and 81.9 $\mu g/g$), mercury (0.102 in OBP-94-07), lead (982 and 55.9 $\mu g/g$), and zinc (952 and 177 $\mu g/g$) (see Figure 5-2). Three former burn surfaces were found in test pit OBP-94-07 from the surface to a depth of 2 feet. At 2 feet, cadmium (11 $\mu g/g$), chromium (23.2 $\mu g/g$), copper (85.3 $\mu g/g$), mercury (0.259 $\mu g/g$), lead (607 $\mu g/g$), zinc (248 $\mu g/g$), and iron (42,200 $\mu g/g$) still exceeded the background concentrations. At 3 feet, there was a possible contact between a natural caliche layer and the disturbed soil. No metal debris was found below a depth of 3 feet. The sample collected at 5 feet bgs only contained elevated levels of copper (30.5 $\mu g/g$), mercury (0.173 $\mu g/g$), and lead (66.6 $\mu g/g$). Copper (31.7 $\mu g/g$), mercury (0.204 $\mu g/g$), lead (96.4 $\mu g/g$), and zinc (116 $\mu g/g$) were detected above background in the 7-foot sample, and lead was the only metal that exceeded background in the 10-foot sample with a concentration of 50.9 $\mu g/g$.

Overall, soils in test pit OBP-94-08 contained less metals contamination than those of OBP-94-07. No debris was present on the surface, but wood and metal debris were found between the surface and 3 feet. Concentrations of copper (81.9 $\mu g/g$), lead (55.9 $\mu g/g$), and zinc (177 $\mu g/g$) exceeding background were detected in the surface sample. The sample collected at 2 feet contained elevated concentrations of cadmium (5.14 $\mu g/g$), mercury (0.706 $\mu g/g$), lead

(25.6 μg/g), thallium (46.7 μg/g), vanadium (30.8 μg/g), and zinc (137 μg/g). Below 3 feet, there was a natural deposit of calcium carbonate-cemented gravel. The 5-, 7-, and 10-foot samples were free of metals contamination.

Wood and metal (banding) debris were scattered across the surface of test pit OBP-94-09, which was excavated over a smaller geophysical anomaly to the northwest. Elevated levels of potassium were detected in surface soil and 2-foot samples collected from this test pit. Test pit OBP-94-12, located south of the revetment area, had elevated concentrations of magnesium and sodium at 5 and 7 feet. Calcium was above background at 7 feet in this sample. Sodium was still above background at 10 feet. Glass and metal debris were present on the surface around test pit OBP-94-12, but no debris was found below the ground surface. This test pit was located over the same large geophysical anomaly where explosive and metals contaminants were previously detected in Test Pit No. 3 from the Phase I RI (see Figure 5-2).

Test pit OBP-94-10, excavated southwest of the revetments, was located on a 10-by-10-foot mound of soil. Metal debris, consisting of wire rods, ammo hoses, banding, and cartridge cases (see Appendix B), was found between 0 and 3 feet bgs. There was a distinct soil change between the silty, fill dirt and the gravelly caliche layer at a depth of 2 feet. Arsenic (34 μg/g), cadmium (1.38 μg/g), chromium (26.1 μg/g), copper (38.7 μg/g), lead (89.4 μg/g), zinc (355 μg/g), and iron (26,800 μg/g) were all detected above the background concentrations in the surface-soil sample. No contamination was detected in the subsurface samples collected at 2, 5, 7, and 10 feet with the exception of iron (26,400 μg/g) at 7 feet.

As shown in Figure 5-3, lead was the most common metal detected above the background threshold value in 1994 surface soil samples collected at the site. Concentrations ranged from 18.6 in OBS-94-21 μg/g in OBS-94-21 to 270 μg/g in OBS-94-15. Copper and zinc were also detected in several samples in concentrations above background. Sample OBS-94-18 had the most metals detected above background: cadmium (1.8 μg/g), cobalt (7.75 μg/g), copper (76.9 μg/g), chromium (23.2 μg/g), lead (68.2 μg/g), vanadium (30.3 μg/g), zinc (173 μg/g), magnesium (9,870 μg/g), and potassium (7,260 μg/g). Arsenic exceeded background in only one sample, OBS-94-13, at 17.6 μg/g. In the same sample, zinc was reported by the laboratory as greater than 10,000 μg/g. A second sample (OBS-95-39) collected in November 1995 at the same location yielded a zinc value of 5,700 μg/g as well as elevated cadmium (4.24 μg/g), copper (9,900 μg/g), and lead (376 μg/g). This location was covered with surface metal debris and represents a hot spot location.

The area outside of the revetments appears to be contaminated by a variety of metals. The areas of geophysical anomalies correspond to buried and burned metals in former trenches. The burning activities that occurred in these trenches were also a source of widespread surface metals contamination. The 32 surface soil samples collected during the Phase II RI did not completely define the horizontal extent of surface contamination. Some boundaries were not defined; for example, OBS-94-23, located on the northwest corner of SWMU 6, had elevated concentrations of barium, copper, lead, and zinc. Metals contamination was also detected in the northeast corner of the SWMU and in drainage areas north of the SWMU boundary. The vertical extent of contamination was outlined in several of the test pits excavated outside of the revetment area. Inside the revetment area, however, it appears that greater vertical migration

of metals has occurred. The vertical extent of migration, in some cases, was not defined by the Phase II RI field sampling although elevated metals concentrations generally were found to be decreasing with depth. The explosives that were detected during the Phase I investigation were not confirmed during the Phase II investigation, with the exception of the RDX detected inside the revetment.

The additional sediment samples collected in the fall of 1995, from the gullies north of the interceptor ditch, were found to contain several metals that exceed background concentrations but are well below corresponding risk-based concentrations (see Figure 5-3). The most frequently detected metals exceeding background were copper (5 of 8 samples ranging from 24.8 to 78.4 $\mu g/g$) and lead (7 of 8 samples ranging from 21.2 to 78.5 $\mu g/g$). No explosive contaminants were detected in these samples. It appears that some metals contamination within the gullies may have occurred prior to the installation of the interceptor ditch. The metals detected in sediments north of the ditch are consistent with concentrations of the same metals located in sediments south of the ditch. There were no identified hot spots or areas of concern related to the gullies draining the SWMU 6 area.

As previously described, one sample was collected in November 1995 to confirm previous results that indicated zinc concentrations that exceeded 10,000 $\mu g/g$. The approximate location of the first sample (OBS-94-13) was revisited, and the second sample (OBS-95-39) was found to contain zinc at a concentration of 5,700 $\mu g/g$. Additionally, cadmium (4.24 $\mu g/g$), copper (9,900 $\mu g/g$), and lead (376 $\mu g/g$) were present at elevated concentrations. These metals are associated with a small area containing surface metal debris.

5.1.3.3.3 ***Dioxins/Furans Results.*** Dioxins were analyzed during the 1995 field investigation. Thirty-two surface soil samples and three field duplicates, and eight sub-surface samples and one duplicate were collected in November 1995 at SWMU 6 for dioxin and furan analysis.

The samples were analyzed by USEPA SW-846 Method 8290 (Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry). Table 5-6 presents a list of analytes and corresponding codes, and Figure 5-4 shows soil sample locations and total dioxin/furan detects. It should be noted that the totals provided on the location map were calculated by summing all furan detects separately and all dioxin detects separately for each site identification. This was done to provide an easier representation of the relative concentrations of the large amount of detected analytes. Upon special request, the analytical laboratory will calculate total dioxins and furans by homologous series (i.e., total heptachlorodibenzodioxins (total HPCDDs), total tetrachlorodibenzofurans (total TCDFs) etc.) not normally reported by Method 8290.

To determine if burn horizons previously observed in former trenches at SWMU 6 contained dioxins/furans, four test pits (OBP-95-01 through OBP-95-04) were excavated and sampled. Samples were collected at the surface, within the burn horizon, and below the burn horizon. The following discussion summarizes the results for each test pit.

Table 5-6. List of Dioxins/Furans and Analyte Codes

Analyte Code	Analyte
234HXF	2,3,4,6,7,8-Hexachlorodibenzofuran
234PCF	2,3,4,7,8-Pentachlorodibenzofuran
678HPD	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin
678HPF	1,2,3,4,6,7,8-Heptachlorodibenzofuran
678HXD	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin
678HXF	1,2,3,6,7,8-Hexachlorodibenzofuran
789HPF	1,2,3,4,7,8,9-Heptachlorodibenzofuran
789HXD	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin
789HXF	1,2,3,7,8,9-Hexachlorodibenzofuran
78HXDD	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin
78HXDF	1,2,3,4,7,8-Hexachlorodibenzofuran
78PCDD	1,2,3,7,8-Pentachlorodibenzo-p-dioxin
78PCDF	1,2,3,7,8-Pentachlorodibenzofuran
OCDD	Octachlorodibenzodioxin - nonspecific
OCDF	Octachlorodibenzofuran - nonspecific
TCDD	2,3,7,8-Tetrachlorodibenzodioxin
TCDF	2,3,7,8-Tetrachlorodibenzofuran

Test pit OBP-95-01, located within the revetment trench area, was excavated to a depth of 5 feet with samples collected at 0 to 6 inches, 2 feet, and 4 feet. Total dioxins detected in test pit OBP-95-01A (0.5 foot) were equal to 145 ppt (parts per trillion); total furans detected were equal to 159 ppt. The furan detects included 234HXF, 678HPF, 678HXF, 789HPF, 789HXF, 78PCDF, OCDF, and TCDF with concentrations ranging from 1.23 ppt (78PCDF) to 102 ppt (OCDF). The dioxins detected included 678HPD, 789HXD, 78HXDD, and OCDD. The minimum value was 0.992 ppt (78HXDD), and the maximum value was 119 ppt (OCDD). Total dioxins detected in sample OBP-95-01B (2 feet) were equal to 1,048 ppt; total furans detected were equal to 28.2 ppt. The furan concentrations (234HXF, 234PCF, 678HPF, 678HXF, 78HXDF, 78PCDF, OCDF, and TCDF) ranged from 0.39 ppt (78PCDF) to 13.4 ppt (OCDF). The dioxins detected (678HPD, 678HXD, 789HXD, 78HXDD, 78PCDD, OCDD, and TCDD) had concentrations in the range of 0.85 ppt (TCDD) to 770 ppt (OCDD). No dioxins or furans were detected at this sample location (OBP-95-01C (4 feet)).

Test pit OBP-95-02, located in the central portion of the revetment area near the areas described as geophysical anomalies, was excavated to a depth of 8 feet with samples collected at 0 to 6 inches, 5 feet, and 7 feet. Only one dioxin (OCDD) was detected at 10.6 ppt in sample OBP-95-02A (6 inches); 78HXDF was detected once at 0.34 ppt. In sample OBP-95-02B (5 feet), total dioxins detected were equal to 1,171 ppt, while total furans detected were only 164 ppt. The furans detected included 234HXF, 234PCF, 678HPF, 678HXF, 789HPF, 78HXDF, 78PCDF, OCDF, and TCDF, with concentrations ranging from 5.0 ppt (789HPF) to 36.7 ppt (678HPF). Dioxin concentrations ranged from 2.51 ppt (TCDD) to 711 ppt (OCDD), and the analytes included 678HPD, 678HXD, 789HXD, 78HXDD, 78PCDD, OCDD, and TCDD. Total dioxins detected in OBP-95-02C (7 feet) were equal to 617 ppt

(17 ppt in the duplicate sample); total furans detected were equal to 28 ppt (9.73 ppt in the duplicate sample). The analyte 234HXF was detected in the sample and duplicate (1.56 ppt and 0.31 ppt, respectively). The compound 678HPF was detected in the sample at 7.57 ppt but not in the duplicate sample, and 678HXF was detected at 0.76 ppt in the sample but not detected in the duplicate. The analyte 78HXDF (2.26 ppt) was detected in the sample but not detected in the duplicate. Also, OCDF (13.6 ppt) was detected in the sample but not in its duplicate. TCDF was present in both the sample and duplicate at 2.23 and 0.42 ppt, respectively. The compound 678HPD was detected at 190 ppt in the sample while only 4.56 ppt was found in the duplicate; 678HXD at 17.1 ppt was found in the primary sample but was much lower in the duplicate (0.45 ppt). The compound 789HXD (32.4 ppt) was found in the primary sample only. Likewise, 78PCDD (10.1 ppt) was detected in the sample but not found in the duplicate. The compound OCDD at 367 ppt and 12.0 ppt was found in both the primary and duplicate samples, respectively.

Test pit OBP-95-03, located just west of the revetment trench area, was excavated to a depth of 4 feet with samples collected at 0 to 6 inches, 1.5 feet, and 4 feet. Total dioxins detected in OBP-95-03A (6 inches) were 1,381 ppt, and total furans were 193 ppt. The furans detected included 234HXF, 234PCF, 678HPF, 678HXF, 789HPF, 78HXDF, 78PCDF, OCDF, and TCDF with concentrations ranging from 2.48 ppt (789HPF) to 54.4 ppt (678HPF). The dioxins included 678HPD, 678HXD, 789HXD, 78HXDD, 78PCDD, OCDD, and TCDD with concentrations ranging from 3.24 ppt (TCDD) to 931 ppt (OCDD). Sample OBP-95-03B (1.5 feet) had total dioxins equal to 2,125 ppt; total furans detected were only 400 ppt. Furans detected included 234HXF, 234PCF, 678HPF, 678HXF, 789HPF, 789HXF, 78HXDF, 78PCDF, OCDF, and TCDF, ranging from 5.82 ppt (789HXF) to 98.8 ppt (TCDF). The dioxins ranged from 6.02 ppt (TCDD) to 1,410 ppt (OCDD), which included 678HPD, 678HXD, 789HXD, 78HXDD, 78PCDD, OCDD, and TCDD. Total dioxins detected in OBP-95-03C (4 feet) were 59.4 ppt; total furans detected were 3.5 ppt. The furans, 234HXF, 234PCF, 789HXF, 78PCDF, and TCDF, had concentrations from 0.19 ppt (789HXF) to 2.03 ppt (TCDF). Dioxins (678HPD, 678HXD, 789HXD, and OCDD) were in the range of 1.37 ppt (678HXD) to 41.7 ppt (OCDD).

Test pit OBP-95-04, located just west of the revetment trench area and south of test pit OBP-95-03, was excavated to a depth of 2.5 feet with samples collected at 0 to 6 inches, 1 foot, and 2.5 feet. Total dioxins detected in OBP-95-04A (6 inches) were equal to 147 ppt; total furans detected were equal to 25.7 ppt. The compounds 678HPF, 678HXF, OCDF, and TCDF were detected in the soil from 0.28 ppt (678HXF) to 18.3 ppt (OCDF). Only two dioxins (678HPD and OCDD) were detected with concentrations of 20.1 ppt and 127 ppt, respectively. The compound OBP-95-04B (1 foot) contained 207 ppt total dioxins; total furans detected were only 42.9 ppt. Furan detections consisted of 234PCF, 678HPF, 78HXDF, 78PCDF, OCDF, and TCDF. The concentrations were in the range of 2.2 ppt (234PCF) to 17.0 ppt (OCDF). The compounds 678HPD, 789HXD, 78PCDD, and OCDD were detected at 38.2 ppt, 3.55 ppt, 1.52 ppt, and 164 ppt, respectively. Total dioxins detected in OBP-95-04C (2.5 feet) were 11.4 ppt, while total furans detected were equal to 3.7 ppt. Two furans (OCDF and TCDF) had concentrations of 3.3 ppt and 0.45 ppt, respectively. The compound 678HPD was detected at 2.09 ppt, and OCDD was found at 9.29 ppt.

In summary, the burn horizon for each test pit (i.e., the middle sample location) was found to contain elevated levels of a variety of dioxins/furans, whereas soils collected below the burn horizon contained much lower or no appreciable levels of dioxins or furans, indicating that significant vertical migration has not occurred.

Surface soil samples (nominally 0-to-6-inch soil depth) were collected at 28 locations designed to detect possible airborne spread of dioxin/furan contamination resulting from burning activities in the revetment/trench area, and to identify other possible burn areas. The analytical results for samples OBS-95-01 through OBS-95-28 (including three field duplicates) are summarized in the following discussion and are shown in Figure 5-4.

Only one detect of TCDF occurred in sample OBS-95-01 (0 to 6 inches) with a value of 1.21 ppt.

Only furans were detected in OBS-95-02 (0 to 6 inches) for a total of 17.2 ppt. The analytes included 234HXF, 234PCF, 678HXF, 789HXF, OCDF, and TCDF. The minimum concentration was 0.439 ppt (234PCF) and the maximum value was 12.4 (OCDF).

Only furans were detected in OBS-95-03 (0 to 6 inches) for a total of 12.3 ppt. The analytes included 234HXF, 678HXF, and OCDF, ranging from 0.636 ppt to 10.1 ppt.

In OBS-95-04 (0 to 6 inches), only furans were detected for a total of 5.4 ppt. The analytes included 678HXF, 789HXF, and OCDF (4.76 ppt).

Total dioxins detected in OBS-95-05 (0 to 6 inches) were equal to 58.5 ppt; total furans detected were 7.6 ppt. The compounds 789HPF, 78HXDF, 78PCDF, and OCDF were detected with concentrations ranging from 0.174 ppt (78PCDF) to 6.65 ppt (OCDF). Three dioxins (678HPD, 78PCDD, and OCDD) were found with values of 4.37 ppt, 0.207 ppt, and 53.9 ppt, respectively.

Only one detect of 78HXDF occurred in OBS-95-06 (0 to 6 inches) with a concentration of 0.2 ppt.

Total dioxins detected in sample OBS-95-07 (0 to 6 inches) were only 19 ppt, and total furans detected were equal to 7.5 ppt. Only three furans (234PCF, 789HPF, and OCDF) were found with concentrations of 0.182 ppt, 0.557 ppt, and 6.76 ppt, respectively. The compounds 678HPD (2.25 ppt) and OCDD (16.4 ppt) were the only two dioxins detected.

Only 678HPD was detected in OBS-95-08 (0 to 6 inches) with a concentration of 1.03 ppt.

Total dioxins detected in sample OBS-95-09 (0 to 6 inches) were only 1.6 ppt; total furans were only 0.5 ppt. Two furans (234PCF and 78HXDF) were detected. The only dioxins detected at very low concentrations were 678HPD, 78PCDD, and TCDD.

In sample OBS-95-10 (0 to 6 inches), the total dioxins detected in the duplicate sample were 16.6 ppt; 1.2 ppt 678HPD was detected in the primary sample. Total furans in duplicate sample were equal to 19.6 ppt. The compound 234PCF was detected in the duplicate (0.64 ppt) but not in the primary sample, and 789HPF was also detected in the duplicate (1.46 ppt) but not in the primary sample. The analyte 789HXF occurred in the primary sample (0.08 ppt) but was not detected in the duplicate, while 78HXDF was found in the duplicate sample at 1.03 ppt but not in the primary sample. The compound OCDF was found both in the primary and duplicate sample (4.28 ppt and 16.5 ppt, respectively), but the primary sample was removed as a true detect using the 5x rule for blank contamination. The analyte 678HPD was found in the primary but not in the duplicate sample at 1.18 ppt, while OCDD was found in the duplicate sample at 16.6 ppt, but blank contamination in the primary sample exceeded the 5x rule.

Only 1 dioxin (678HPD) was detected in OBS-95-11 (0 to 6 inches) at a concentration of 1.47 ppt. The analytes 789HXF and 78HXDF were detected at a total concentration of 0.7 ppt.

Total dioxins detected in OBS-95-12 (0 to 6 inches) were 156 ppt; total furans detected were equal to 12.4 ppt. Three furans (789HXF, 78HXDF, and OCDF) were detected with concentrations of 0.129 ppt, 0.58 ppt, and 11.7 ppt, respectively. The compounds 678HPD, 678HXD, 78HXDD, and OCDD were the only dioxins detected (at 13.9 ppt, 0.45 ppt, 0.17 ppt, and 141 ppt, respectively).

Total dioxins detected in OBS-95-13 (0 to 6 inches) were 628 ppt; total furans detected were equal to 36.9 ppt. The furans included 234PCF, 678HPF, 789HPF, 789HXF, 78HXDF, and OCDF with concentrations ranging from 0.13 ppt (234PCF) to 21.4 ppt (OCDF). The dioxins included 678HPD, 678HXD, 789HXD, 78HXDD, OCDD, and TCDD with detections ranging from 0.35 ppt (TCDD) to 558 ppt (OCDD).

OBS-95-14 (0 to 6 inches) had total dioxins equal to 1,263 ppt and total furans equal to 196 ppt. The furans included 234HXF, 234PCF, 678HPF, 678HXF, 789HPF, 789HXF, 78HXDF, 78PCDF, OCDF, and TCDF with concentrations ranging from 0.67 ppt (234PCF) to 140 ppt (OCDF). The dioxin detects included 678HPD, 678HXD, 789HXD, 78HXDD, 78PCDD, and OCDD with concentrations ranging from 0.96 ppt (78PCDD) to 1,120 ppt (OCDD).

OBS-95-15 (0 to 6 inches) had total dioxins equal to 26.9 ppt; total furans detected were 0.33 ppt. The only furans detected were 78HXDF and 78PCDF with concentrations of 0.19 ppt and 0.14 ppt, respectively. The dioxins detected were 678HPD, 78PCDD, and OCDD at 4.07 ppt, 0.30 ppt, and 22.5 ppt, respectively.

Total dioxins detected in OBS-95-16 (0 to 6 inches) were 46.6 ppt. Only 1 furan (789HPF) was detected in soil with a concentration of 0.43 ppt. The three dioxins were 678HPD, 78PCDD, and OCDD (41.1 ppt).

Total dioxins detected in sample OBS-95-17 (0 to 6 inches) were equal to 527 ppt; total furans detected were equal to 80 ppt. The furans included 234HXF, 234PCF, 678HPF, 678HXF, 789HPF, 789HXF, 78HXDF, 78PCDF, OCDD and TCDF with concentrations ranging from 0.842 ppt (789HXF) to 30.7 ppt (678HPF). The dioxins detects included 678HPD, 678HXD, 789HXD, 78HXDD, 78PCDD, OCDD, and TCDD, ranging from 0.68 ppt (TCDD) to 391 ppt (OCDD).

Sample OBS-95-18 (0 to 6 inches) had total dioxins detected of 105 ppt; total furans were 7.4 ppt. The furans included 234PCF, 678HXF, 78HXDF, 78PCDF, and TCDF; the values were in the range of 0.74 ppt (78PCDF) to 3.36 ppt (TCDF). The dioxins included detects ranging from 1.19 ppt (78HXDD) to 67.2 ppt (OCDD); the analytes were 678HPD, 678HXD, 789HXD, 78HXDD, 78PCDD, and OCDD.

Sample OBS-95-19 (0 to 6 inches) had 379 ppt total dioxins and 35 ppt total furans. Detected furans included 234PCF, 678HPF, 678HXF, 789HPF, 78HXDF, 78PCDF, OCDF, and TCDF; the concentrations ranged from 0.75 ppt (789HPF) to 11.9 (OCDF). Dioxins included 678HPD, 678HXD, 789HXD, 78PCDD, and OCDD with concentrations ranging from 1.09 ppt (78PCDD) to 317 ppt (OCDD).

Sample OBS-95-20 (0 to 6 inches) had 43.3 ppt total dioxins; the duplicate sample had 42.5 ppt. Total furans detected were equal to 0.70 ppt, but only 0.51 ppt 78HXDF was detected in the duplicate sample. The compound 234PCF was detected in the primary sample but not in the duplicate, whereas 78HXDF was detected in the duplicate but not in the primary sample. The compound 78PCDF was detected in the primary sample but not in the duplicate, while 78HXDF was detected at 0.51 ppt in the duplicate sample but not in the primary sample. All furan detects were less than 0.6 ppt. There was good agreement between the 678HPD detects between primary and duplicate samples (5.27 ppt and 5.63 ppt, respectively), and OCDD (37.9 ppt and 36.6 ppt, respectively). A detect of TCDD (0.14 ppt) was observed in the primary sample only.

Sample OBS-95-21 (0 to 6 inches) had 1.3 ppt total dioxins and 110 ppt total furans. Furans included 234HXF, 234PCF, 789HXF, OCDF, and TCDF, ranging from 0.64 ppt (234PCF) to 99.9 ppt (OCDF). Three dioxins (678HXD, 789HXD, and TCDD) were detected with a maximum concentration of 0.61 ppt (789HXD).

Total dioxins detected in OBS-95-22 (0 to 6 inches) were 700 ppt; total furans detected were equal to 123 ppt. Total furans included detects of 234HXF, 234PCF, 678HPF, 678HXF, 789HPF, 789HXF, 78PCDF, OCDF, and TCDF with a maximum value of 66.3 ppt (OCDF) and a minimum value of 1.50 ppt (789HXF). Dioxin detects included 678HPD, 678HXD, 789HXD, 78HXDD, 78PCDD, and OCDD (604 ppt). The lowest detect was 1.29 ppt (78PCDD).

Total dioxins detected in sample OBS-95-23 (0 to 6 inches) were 152 ppt; total furans detected were equal to 56 ppt. Total furans included detects of 234HXF, 789HPF, 789HXF, 78PCDF, OCDF, and TCDF with concentrations ranging from 0.72 ppt (78PCDF) to 43.9 ppt (OCDF).

The analytes 678HPD, 678HXD, 789HXD, and OCDD were the only dioxin detects, ranging from 0.96 ppt (678HXD) to 131 ppt (OCDD).

No dioxins were detected in OBS-95-24 (0 to 6 inches); however, total furans detected were equal to 14.2 ppt. Furan detects included 678HXF, 789HXF, OCDF, and TCDF with a maximum value of 12.1 ppt (OCDF) and a minimum value of 0.44 ppt (789HXF).

Only 1 dioxin was detected in OBS-95-25 (0 to 6 inches) at 0.47 ppt (78PCDD). Total furans detected were 17 ppt, including 678HXF (0.87 ppt), OCDF (14.0 ppt), and TCDF (2.29 ppt).

Total dioxins detected in OBS-95-26 (0 to 6 inches) were 147 ppt; total furans detected were equal to 186 ppt. Furan detects included 234HXF, 234PCF, 678HPF, 678HXF, 789HPF, 78PCDF, OCDF, and TCDF with concentrations ranging from 2.01 ppt (78PCDF) to 123 ppt (OCDF). Dioxin detects included 678HPD, 678HXD, 78HXDD, 78PCDD, and OCDD. The highest detect was for OCDD (129 ppt), and the minimum detect of 0.65 ppt was observed for 78PCDD.

No dioxins were detected in OBS-95-27 (0 to 6 inches); total furans were only 10 ppt. Only OCDF and TCDF were detected in soil at this location.

In OBS-95-28 (0 to 6 inches), total dioxins detected were equal to 178 ppt; no dioxins were detected in the duplicate sample. Total furans detected were equal to 24.5 ppt (duplicate sample had 16.2 ppt). The compound 234HXF was detected in the primary sample (3.15 ppt) but not in the duplicate, and 234PCF was also found in the primary sample at 0.50 ppt but not in its duplicate. The analyte 678HXF was detected at 0.96 ppt in the primary sample but not detected in the duplicate, while 78PCDF was detected in both the primary and duplicate samples at 0.70 ppt and 0.83 ppt, respectively. There was good agreement between the primary and duplicate analyses for OCDF (18.2 ppt and 15.4 ppt, respectively). TCDF was detected in the primary sample at 1.04 ppt. The compound 678HPD was detected in both the primary and duplicate samples at 17.0 ppt and 16.7 ppt, respectively, and 678HXD was detected in only the primary sample at 0.86 ppt. OCDD results were in agreement with 160 ppt in the primary sample and 146 ppt in the duplicate. The analyte TCDD was detected in only the primary sample at 0.37 ppt.

The majority of the surface soil samples, with the exception of OBS-95-14, had total dioxins or total furan concentrations below 100 ppt. The elevated concentrations associated with OBS-95-14 (1,263 ppt total dioxins; 196 ppt total furans) may be due to previous burning in that area as indicated by scrap metal and debris. It should be pointed out, however, that the levels in this sample are not much higher than the levels in surface soil sample BKS-95-07 (847 ppt total dioxins, 78 ppt total furans), which was collected for background purposes.

5.1.3.3.4 ***Background Dioxin/Furan Phase II Results.*** Four additional surface soils were collected at locations presumed to be outside of the dominant wind direction(s) from SWMU 6, and to be generally free from potential dioxin/furan contamination. These samples were

designed to provide background levels for comparison to samples suspected to be contaminated by dioxins/furans. See Figure 2-2 and Table 5-7 for sample locations BKS-95-06 through BKS-95-09 and a summary of detected analytes.

Sample BKS-95-06 (0 to 6 inches) had only one dioxin (789HXD) detected at 0.57 ppt; total furans detected were equal to 64.2 ppt. Furan detects included 234HXF, 234PCF, 678HXF, 789HPF, 789HXF, OCDF, and TCDF with concentrations ranging from 1.36 ppt (234PCF) to 45.8 ppt (OCDF).

Total dioxins detected in BKS-95-07 (0 to 6 inches) were equal to 847 ppt; total furans detected were only 77.8 ppt. Furans included 234HXF, 234PCF, 678HXF, 78PCDF, OCDF, and TCDF. The minimum value was 1.05 ppt (234PCF) and the highest value was 67.9 ppt (OCDF). The analytes 678HPD, 678HXD, 78PCDD, and OCDD were detected at 104 ppt, 3.83 ppt, 0.33 ppt, and 739 ppt, respectively.

No dioxins were detected in BKS-95-08 (0 to 6 inches); however, 12.3 ppt total furans were detected. Furan detects included 234HXF, 234PCF, OCDF, and TCDF at concentrations of 1.50 ppt, 0.16 ppt, 10.3 ppt, and 0.37 ppt, respectively.

Sample BKS-95-09 (0 to 6 inches) had no dioxins detected, and only 4.6 ppt total furans. Furan detects included 234PCF, OCDF, and TCDF at 0.32 ppt, 3.57 ppt, and 0.71 ppt, respectively.

Three of the four background surface soil samples (BKS-95-06, -08, and -09) have relatively similar levels of dioxins and furans. Sample BKS-95-07 has elevated concentrations of both dioxins and furans; however, these levels may be well within normal conditions given the small sample size.

5.1.4 Human Health Risk Assessment

As part of the Phase II RI, an RA was conducted to estimate potential human health risks associated with the no-action alternative for SWMU 6, the Old Burn Area. The following tasks were completed in the RA:

- Data analysis and selection of COPCs
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Conclusions and recommendations

This section provides a summary of the quantitative process employed at SWMU 6 and the results of that process. The RA for SWMU 6 is based on the methodology described in Section 3.1 and supported by Appendices L, M, N, and O.

Table 5-7. Summary of Analytes Detected in Soil for the Dioxin Background - Phase II

Group		Analytes	Background Concentrations	BK6-95-06 (0.5ft)	BK6-95-07 (0.5ft)	BK6-95-08 (0.5ft)	BK6-95-09 (0.5ft)
DIOXINS	678HPD	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	N/A	0.00000655#	0.000104*	0.00000352#	0.0000032#
	678HXD	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	N/A	LT 0.00000055	0.00000383*	LT 0.00000036	LT 0.00000055
	678HXF	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	N/A	0.00000203*	0.00000109*	LT 0.0000003	LT 0.00000035
	789HXD	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	N/A	0.000000566*	LT 0.0000009	LT 0.00000046	LT 0.0000007
	789HXF	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	N/A	0.00000146*	LT 0.00000088	LT 0.00000041	LT 0.00000052
	78PCDD	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	N/A	LT 0.00000054	0.00000033*	LT 0.00000013	LT 0.00000018
	78PCDF	1,2,3,7,8-PENTACHLORODIBENZOFURAN	N/A	LT 0.00000082	0.00000326*	LT 0.00000013	LT 0.00000017
	234HXF	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	N/A	0.00000584*	0.00000276*	0.0000015*	LT 0.00000058
	234PCF	2,3,4,7,8-PENTACHLORODIBENZOFURAN	N/A	0.00000136*	0.00000105*	0.000000162*	0.000000315*
	TCDF	2,3,7,8 TETRACHLORODIBENZOFURAN	N/A	0.00000248*	0.00000177*	0.000000366*	0.000000714*
	OCDD	OCTACHLORODIBENZODIOXIN	N/A	0.0000301#	0.000739*	0.0000266#	0.0000186#
	OCDF	OCTACHLORODIBENZOFURAN	N/A	0.0000458*	0.0000679*	0.0000103*	0.00000357*
	789HPF	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	N/A	0.0000052*	LT 0.00000264	LT 0.00000133	LT 0.00000039

Note.- All values in µg/g (equal to ppm).
N/A = Not Applicable.
* = Organic analyte detected above CRL or MDL or detected inorganic analyte exceeding background.
# = Analyte was detected in the associated blank in excess of the 5 or 10 times rule (as described in Section 3.1.1.1).
LT = Analyte concentration is less than CRL , the CRL is posted next to the "LT".

5.1.4.1 *Selection of the Chemicals of Potential Concern—Soil*

As detailed in USEPA guidance (USEPA 1989a; USEPA 1994), a screening procedure can be used to narrow the list of contaminants at a particular site to a subset of analytes that can be considered the COPCs for the area. This screening procedure can involve up to four steps, depending on the contaminants present:

- Group data by chemical class (e.g., carcinogenic PAHs)
- Evaluate frequency of detection
- Evaluate essential nutrients
- Compare site data to risk-based screening concentrations (Region III values)

Below is the screening analysis for SWMU 6.

5.1.4.1.1 ***Data Grouping.*** The USEPA has provided guidance for assessing the risk of TCDDs/TCDFs based on the relative potency of each compound to 2,3,7,8-TCDD (USEPA 1989c). These TEFs, which are listed after the compounds below, were used to convert the total dioxin/furan concentration of each sample to an equivalent 2,3,7,8-TCDD concentration.

- 2,3,7,8-TCDD: 1
- 2,3,7,8-PeCDD: 0.5
- 2,3,7,8-HxCDDs: 0.1
- 2,3,7,8-HpCDD: 0.01
- OCDD: 0.001
- 2,3,7,8-TCDF: 0.1
- 1,2,3,7,8-PeCDF: 0.05
- 2,3,4,7,8-PeCDF: 0.5
- 2,3,7,8-HxCDFs: 0.1
- 2,3,7,8-HpCDFs: 0.01
- OCDF: 0.001

5.1.4.1.2 ***Frequency of Detection.*** Although thallium was detected in fewer than 5 percent of both surface and subsurface samples, the CRL for thallium exceeded the background threshold value. The detect concentrations were also high compared to background. Therefore, thallium was retained in the database as a preliminary COPC. The following explosives were detected in fewer than 5 percent of samples: 1,3,5-trinitrobenzene (subsurface samples), 2,4-dinitrotoluene (subsurface samples), 2,6-dinitrotoluene (surface samples), 2,4,6-trinitrotoluene (surface and subsurface samples), and RDX (surface and subsurface samples). Because explosives are expected to be present at this site, these compounds were retained as preliminary COPCs.

5.1.4.1.3 ***Nutrient Screening.*** All of the nutrients detected above background in surface soil had maximum detected values that were less than their respective nutrient screening values:

iron (maximum—42,500 μg/g; screening value— 70,000 μg/g), magnesium (maximum—9,870 μg/g; screening value—1,000,000 μg/g), potassium (maximum—7,260 μg/g; screening value—150,000 μg/g), and sodium (maximum—654 μg/g; screening value—1,000,000 μg/g). Therefore, these nutrients were eliminated as COPCs in surface soil.

With the exception of iron, all of the nutrients detected above background in subsurface soil had maximum detected values that were less than their respective nutrient screening values: calcium (maximum—140,000; screening value—1,000,000 μg/g), magnesium (maximum—14,100 μg/g; screening value—1,000,000 μg/g), potassium (maximum—7,260 μg/g; screening value—150,000 μg/g), and sodium (maximum—2,310 μg/g; screening value—1,000,000 μg/g). Therefore, these nutrients were eliminated as COPCs in subsurface soil. The maximum concentration of iron detected in subsurface soil was 290,000 μg/g, which exceeded the nutrient screening value of 70,000 μg/g. Therefore, iron was retained as a preliminary COPC for subsurface soil for SWMU 6.

5.1.4.1.4 ***Region III RBC Screening.*** The final step in the COPC selection process consisted of comparing the EPCs for remaining contaminants in surface and subsurface soil with Region III RBCs. However, before these comparisons were made, a "hot spot" analysis was conducted.

Hot Spot Analysis. For the final selection of COPCs, the SWMU was evaluated for possible "hot spots." For the purposes of the risk assessment, the data were divided into samples collected within the northeastern section of the SWMU around the revetments, the samples collected in 1992 from Test Pit 3, samples collected from the shallow gullies north of the SWMU, and samples collected from the remainder of the SWMU.

Samples from the northeastern corner of the SWMU in the area within and around the revetments contained much higher concentrations of metals than other areas. Samples included in the evaluation of the risk associated with this area of the SWMU were OBS-92-101; OBP-92-101 through 104; OBS-92-201; OBP-92-201 through 204; OBP-94-01A through D; OBP-94-02A through F; OBP-94-03A through D; OBP-94-04A through D; OBP-94-05C through E; OBP-94-06A through E; OBP-94-07A through E; OBP-94-08A through E; OBS-94-13, -14 through -18, and -26 through -28; OBP-95-01A through -04C; OBS-95-10, OBS-95-11, OBS-95-17 through 22; and OBS-95-39 (for a total of 30 surface samples and 45 subsurface samples). With the exception of OBS-95-39, all 1995 samples collected from this area were analyzed for dioxins/furans only.

The samples from Test Pit 3, excavated in 1992, were also segregated for risk assessment purposes. This area was isolated from other sample locations (with respect to a 0.5-acre residential lot), and the concentrations of 1,3,5-trinitrobenzene were high (7.4 and 17.0 μg/g) compared to the ingestion RBC for this chemical (0.39 μg/g). This explosive was not detected in other samples at the SWMU (the CRL ranged from 0.35 to 0.92 μg/g). Samples included in the evaluation of this possible hot spot were OBS-92-301 and OBP-92-301 through -304 (two surface samples and three subsurface samples).

The following twenty surface samples collected from the shallow gullies north of the SWMU were segregated for evaluation: OBS-92-G01 through -G05, OBS-04-29 through -32, OBS-95-26 through -34, OBS-95-40, and OBS-95-41.

The remainder of the SWMU was evaluated using all samples not included in the areas mentioned above (40 surface samples and 16 subsurface samples). All 1995 samples collected from the remainder of the SWMU were analyzed for dioxins/furans only.

Table 5-8 provides a summary of the EPCs for preliminary COPCs in surface and subsurface soil at the designated areas of concern at SWMU 6.

Soil-related Exposure Pathways. To select COPCs for the soils, the EPCs for the areas of concern within the site in surface and subsurface soil were compared to Region III soil ingestion and soil-to-air RBCs. As shown in Table 5-9, in the northeast revetment area, arsenic, copper, and lead were selected as the only COPCs for surface soil. For subsurface soil, aluminum, antimony, arsenic, chromium, copper, iron, lead, thallium, and zinc were retained as COPCs.

At the hot spot at Test Pit 3, 1,3,5-trinitrobenzene was retained as a COPC for subsurface soil. No chemicals were retained as COPCs in surface soil in the gullies. The only chemical retained as a COPC for the remainder of the SWMU was arsenic in surface soil.

5.1.4.1.5 *Site-wide Soils.* Concentrations of the COPCs for surface soils—arsenic, copper, and lead—were calculated on a site-wide basis for the purpose of evaluating site-wide exposure scenarios. Site-wide concentrations were calculated utilizing all surface soil samples collected at SWMU 6. The site-wide concentrations of these surface soil COPCs are provided in Table 5-10.

5.1.4.2 *Selection of the Chemicals of Potential Concern—Groundwater*

The selection of COPCs for the groundwater exposure pathways consist of a two-phase modeling approach. Initially, the *maximum* concentration of each analyte detected in either surface or subsurface soil was compared to the Region III soil-to-groundwater RBC. One-tenth of the value was used for noncarcinogens. If the maximum concentration of a chemical exceeded the soil-to-groundwater RBC, the chemical was selected for vadose zone modeling (Table 5-11). The modeled break-through concentration in groundwater for these chemicals was then compared to the Region III tap water RBCs, with one-tenth of the value used for noncarcinogens. In addition, the modeled break-through time was compared to the 100-year cut-off period as described in Section 2.7.2. A chemical that reached the water table within 100 years *and* had a modeled break-through concentration that exceeded the Region III tap water RBC (one-tenth of the value for noncarcinogens) was retained for further vadose-saturated zone modeling to on- and off-site hypothetical receptors as described in Section 2.7.2. For this second phase of modeling, the *average* surface and subsurface soil concentration was used to calculate the initial pore water concentration at the site. Again, the

Table 5-8. Summary of Preliminary Chemicals of Potential Concern (SWMU 6)

Chemical	Frequency of Detection[a]	Range of Detected Values (μg/g)[b]	Range of Reporting Limits (μg/g)	Arithmetic Mean Concentration (μg/g)	95% UCL[c] Concentration (μg/g)	Exposure Point Concentration[d] (μg/g)
Northeast Revetment Area - Surface Soil						
Arsenic	17/19	2.68 - 17.6	24 - 240	9.33	15.8	15.8
Barium	18/19	44.1 - 380	3.29	214	500	380
Boron	1/1[e]	21.7	NA	NA	NA	21.7
Cadmium	5/19	1.59 - 10.0	0.42 - 1.20	1.32	2.39	2.39
Chromium	18/19	9.37 - 39.3	1.04	17.5	21.4	21.4
Cobalt	15/17	2.73 - 7.75	2.50	4.30	5.10	5.10
Copper	18/19	10.5 - 9,900	2.84	185	1,270	1,270
Lead	18/19	11.7 - 12,000	7.44	503	4,475	4,475
Mercury	3/19	0.102 - 0.304	0.03 - 0.05	0.046	0.076	0.076
Nickel	17/19	3.86 - 23.3	2.46 - 2.74	9.30	11.4	11.4
Nitrate	1/2	6.0	3.36	3.84	NA	6.0
Silver	2/19	0.085 - 1.20	0.80	0.431	0.535	0.535
Vanadium	13/17	13.5 - 30.3	1.41 - 3.56	16.1	20.2	20.2
Zinc	18/18	35.9 - 5,700	NA	340	1,109	1,109
Northeast Revetment Area - Subsurface Soil						
Aluminum	12/29	6,270 - 28,100	1,100 - 1,180	5,357	13,894	13,894
Antimony	1/37	60.6	19.6 - 340	17.1	22.4	22.4
Arsenic	21/37	2.68 - 95.2	2.5 - 240	11.4	22.3	22.3
Barium	27/37	56.0 - 2,300	8.77 - 10.1	192	521	521
Cadmium	5/37	3.98 - 46.5	0.42 - 25.0	1.90	3.49	3.49
Chromium	26/37	5.96 - 220	1.16 - 1.62	18.9	46.3	46.3
Cobalt	12/29	2.63 - 9.40	2.50	2.39	3.0	3.0
Copper	31/37	3.32 - 10,000	2.84	123	593	593
Iron	21/37	6,500 - 290,000	1,300 - 1,490	18,211	53,680	53,680
Lead	24/37	7.0 - 17,000	7.44	262	1,548	1,548
Mercury	14/37	0.054 - 0.706	0.03 - 0.05	0.068	0.10	0.10
Nickel	22/37	3.36 - 110	2.46 - 2.74	6.39	10.2	10.2
Silver	8/37	0.035 - 12.0	0.80	0.608	0.913	0.913
Thallium	2/37	46.7 -347	34.3 - 170	34.6	46.4	46.4
Vanadium	8/29	15.8 - 34.8	3.15 - 3.56	6.68	12.6	12.6
Zinc	26/37	16.2 - 11,000	3.00 - 3.92	604	5,169	5,169
Nitrate	2/8	4.58 - 9.47	3.36	2.85	5.83	5.83

Table 5-8. Summary of Preliminary Chemicals of Potential Concern (SWMU 6) (continued)

Chemical	Frequency of Detection[a]	Range of Detected Values (µg/g)[b]	Range of Reporting Limits (µg/g)	Arithmetic Mean Concentration (µg/g)	95% UCL[c] Concentration (µg/g)	Exposure Point Concentration[d] (µg/g)
Northeast Revetment Area - Subsurface Soil *(continued)*						
Bis(2-ethylhexyl)phthalate	1/8	1.10	0.39	0.285	0.549	0.549
RDX	1/37	9.41	0.45 - 1.28	0.671	0.848	0.848
Hot Spot at Test Pit 3 (1992) - Surface Soil						
Butyl benzyl phthalate	1/1	0.283	NA	NA	NA	0.283
Hot Spot at Test Pit 3 (1992) -Subsurface Soil						
Fluoride	1/4	12.4	19.2	10.3	12.4	12.4
Mercury	1/4	0.078	0.03	0.027	0.686	0.078
1,3,5-Trinitrobenzene	2/4	7.4 - 17.0	0.35	7.30	2.3E+11	17.0
2,4,6-Trinitrotoluene	2/4	8.52 - 16.0	0.93	6.88	9.0E+06	16.0
Gully - Surface Soil						
Barium	17/17	106 - 576	NA	195	232	232
Chromium	17/17	8.89 - 22.8	NA	15.5	17.5	17.5
Cadmium	1/17	1.39	0.424 - 1.2	0.539	0.732	0.732
Copper	17/17	14.8 - 78.4	NA	32.4	43.2	43.2
Cobalt	12/12	3.01 - 7.42	NA	5.41	6.22	6.22
Lead	17/17	15.5 - 78.5	NA	36.4	46.7	46.7
Nitrate	5/5	2.76 - 11.4	NA	4.95	13.0	11.4
Zinc	17/17	48.2 - 408	NA	138	203	203
2,4-Dinitrotoluene	3/17	4.5 - 34.0	0.39 - 2.50	2.89	7.74	7.74
2,4,6-Trinitrotoluene	1/17	3.40	0.93 - 2.00	0.985	1.28	1.28
2,6-Dinitrotoluene	2/5[f]	0.580 - 0.780	0.53	0.431	0.658	0.658
Butyl benzyl phthalate	4/5	0.180 - 0.310	0.33	0.226	0.324	0.310
RDX	1/17	8.36	0.45 - 1.28	0.80	1.37	1.37
Remainder of Site - Surface Soil						
Arsenic	22/23	3.55 - 34.0	240	7.98	11.9	11.9
Barium	23/23	87.1 - 796	NA	152	183	183
Boron	1/1[e]	14.0	NA	NA	NA	14.0
Cadmium	2/23	1.38 - 6.98	0.42 - 1.20	0.778	1.02	1.02
Chromium	23/23	8.6 - 26.1	NA	14.7	16.2	16.2
Copper	23/23	9.61 - 139	NA	22.7	29.0	29.0
Lead	21/23	8.36 - 89.4	7.44	20.9	29.9	29.9
Mercury	2/23	0.028 - 0.238	0.05	0.031	0.038	0.038

Table 5-8. Summary of Preliminary Chemicals of Potential Concern (SWMU 6)

Chemical	Frequency of Detection[a]	Range of Detected Values (μg/g)[b]	Range of Reporting Limits (μg/g)	Arithmetic Mean Concentration (μg/g)	95% UCL[c] Concentration (μg/g)	Exposure Point Concentration[d] (μg/g)
Remainder of Site - Surface Soil *(continued)*						
Zinc	23/23	29.1 - 597	NA	113	174	174
2,4-Dinitrotoluene	1/1[g]	0.75	NA	NA	NA	0.75
Di-n-butyl phthalate	1/1	0.210	19.2	NA	NA	0.210
N-nitroso-diphenylamine	1/1	0.051	NA	NA	NA	0.051
Remainder of Site - Subsurface Soil						
2,4-Dinitrotoluene	2/16	1.40 - 25.0	0.39 - 2.50	2.0	4.30	4.30
N-nitroso-diphenylamine	1/4	0.100	0.33	0.149	0.224	0.100

Note.—Range of reporting limits presents CRLs for nondetects only in order to show range of values used to calculated EPCs (1/2 the CRL). An NA means that there were no nondetects for a particular analyte.

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]Micrograms per gram.
[c]Upper confidence limit.
[d]The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (USEPA 1989).
[e]Only one sample was analyzed for boron.
[f]Thirteen sample results were not used in the calculations due to high CRLs.
[g]Twenty-two samples results not used in the calculations due to high CRLs.
[h]Not applicable.

Table 5-9. Selection of Chemicals of Potential Concern for Soil-related Pathways Based . on EPA Region III's RBCs (SWMU 6)

	EPA[a] Region III RBC[b] Screen			
	Residential RBCs (μg/g)[c]			
Chemical	**Ingestion**	**Inhalation**	**Exposure Point Conc. (μg/g)**	**Retained as COPC[d]?**
Northeast Revetment Area - Surface Soil				
Arsenic	0.43	380	15.8	YES
Barium	550	35,000	380	No
Boron	700	NA[e]	21.7	No
Cadmium	3.9	920	2.39	No
Chromium	39	140	21.4	No
Cobalt	470	NA	5.10	No
Copper	310	NA	1,270	YES
Lead	400[f]	NA	4,475	YES
Mercury	2.3	0.7	0.076	No
Nickel	160	6,900	11.4	No
Silver	39.0	NA	0.535	No
Vanadium	55	NA	20.2	No
Zinc	2,300	NA	1,109	No
Northeast Revetment Area - Subsurface Soil				
Aluminum	7,800	NA	13,894	YES
Antimony	3.1	NA	22.4	YES
Arsenic	0.43	380	22.3	YES
Barium	550	35,000	521	No
Cadmium	3.9	920	3.49	No
Chromium	39	140	46.3	YES
Cobalt	470	NA	3.0	No
Copper	310	NA	593	YES
Iron	NA[g]	NA	53,680	YES
Lead	400[f]	NA	1,548	YES
Mercury	2.3	0.7	0.10	No
Nickel	160	6,900	10.2	No
Silver	39.0	NA	0.913	No
Thallium	0.55[h]	NA	46.4	YES
Vanadium	55	NA	12.6	No
Zinc	2,300	NA	5,169	YES
Nitrate	13,000	NA	5.83	No
Bis(2-ethylhexyl)phthalate	46	210	0.549	No
RDX	5.8[i]	NA	0.848	No
Hot Spot at Test Pit 3 (1992) - Surface Soil				
Butyl benzyl phthalate	1,600	53	0.283	No
Hot Spot at Test Pit 3 (1992) - Subsurface Soil				
Fluoride	4,700	NA	12.4	No
Mercury	2.3	0.7	0.078	No

Table 5-9. Selection of Chemicals of Potential Concern for Soil-related Pathways Based on EPA Region III's RBCs (SWMU 6)(continued)

	EPA[a] Region III RBC[b] Screen			
	Residential RBCs (μg/g)[c]			
Chemical	**Ingestion**	**Inhalation**	**Exposure Point Conc. (μg/g)**	**Retained as COPC[d]?**
Hot Spot at Test Pit 3 (1992) - Subsurface Soil (continued)				
1,3,5-Trinitrobenzene	0.39	NA	17.0	**YES**
2,4,6-Trinitrotoluene	21.0	NA	16.0	No
Gully - Surface Soil				
Barium	550	35,000	232	No
Chromium	39	140	17.5	No
Cadmium	3.9	920	0.732	No
Copper	310	NA	43.2	No
Cobalt	470	NA	6.22	No
Lead	400[f]	NA	46.7	No
Zinc	2,300	NA	203	No
Nitrate	13,000	NA	11.4	No
2,4-Dinitrotoluene	16.0	12.0	7.74	No
2,4,6-Trinitrotoluene	21.0	NA	1.28	No
2,6-Dinitritoluene	7.8	37.0	0.658	No
Butyl benzyl phthalate	1,600	53	0.310	No
RDX	5.8	NA	1.37	No
Remainder of Site - Surface Soil				
Arsenic	0.43	380	11.9	**YES**
Barium	550	35,000	183	No
Boron	700	NA	14.0	No
Cadmium	3.9	920	1.02	No
Chromium	39	140	16.2	No
Copper	310	NA	29.0	No
Lead	400[f]	NA	29.9	No
Mercury	2.3	0.7	0.038	No
Zinc	2,300	NA	174	No
2,4-Dinitrotoluene	16.0	12.0	0.75	No
Di-n-butyl phthalate	780	10	0.210	No
N-nitroso-diphenylamine	130	29	0.051	No
Remainder of Site - Subsurface Soil				
2,4-Dinitrotoluene	16.0	12.0	4.30	No
N-nitroso-diphenylamine	130	29	0.100	No

[a]U.S. Environmental Protection Agency.
[b]Risk-based concentrations. RBCs were taken directly from the Region III RBC Table (USEPA 1995), except as noted in the footnotes. Values for noncarcinogens are 1/10 of the Region III RBC.
[c]Micrograms per gram.
[d]Chemicals of potential concern.
[e]Not applicable; value could not be calculated.
[f]OSWER recommended clean-up level for lead in residential soil (USEPA 1994).
[g]No toxicity values are available for iron.
[h]Value for thallic oxide.
[i]Calculated according to Region III guidance (USEPA 1995).

Table 5-10. Site-Wide Surface Soil Exposure Point Concentrations of Chemicals of Potential Concern (SWMU 6)

Chemical	Frequency of Detection[a]	Range of Detected Values (μg/g)[b]	Range of Reporting Limits (μg/g)	Arithmetic Mean Concentration (μg/g)	95% UCL Concentration (μg/g)	Exposure Point Concentration[c] (μg/g)
Arsenic	51/60	2.68 - 34.0	24.0 - 240	11.2	15.0	15.0
Copper	59/60	9.61 - 9,900	2.84	52.6	77.8	77.8
Lead	57/60	8.36 - 12,000	7.44	90.4	148	148

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]Micrograms per gram.
[c]The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (USEPA 1989).

Table 5-11. Selection of COPCs for Groundwater Exposure Pathways (SMWU 6)

Chemical	Maximum Above Background	Depth	Soil-to-GW[b] RBC[c] (mg/g)	Selected for Vadose Zone Modeling?	Reached Water Table Within 100 Years	Model Output: Break-Through Point Concentration in Groundwater	Tap Water RBC (mg/L)[d]	Selected as COPC[e] for Groundwater[f]?
Aluminum	28,100	Subsurface	590[g]	YES	No	---[h]	---	No
Antimony	60.6	Surface	0.27	YES	No	---	---	No
Arsenic	95.2	Subsurface	15	YES	No	---	---	No
Barium	2,300	Subsurface	3.2	YES	No	---	---	No
Boron	21.7	Surface	10.5	YES	No	---	---	No
Cadmium	46.5	Subsurface	0.6	YES	No	---	---	No
Chromium	220	Subsurface	1.9	YES	No	---	---	No
Cobalt	9.4	Subsurface	119[g]	No	No	---	---	No
Copper	10,000	Subsurface	31[g]	YES	No	---	---	No
Fluoride	12.4	Subsurface	0.8	YES	No	---	---	No
Iron	290,000	Subsurface	NA	No	No	---	---	No
Lead	17,000	Subsurface	15	YES	No	---	---	No
Mercury	0.706	Surface	0.3[g]	YES	No	---	---	No
Nickel	110	Subsurface	2.1	YES	No	---	---	No
Silver	12.0	Subsurface	19[g]	No	No	---	---	No
Thallium	347	Subsurface	0.04	YES	No	---	---	No
Vanadium	34.8	Subsurface	5.2[g]	YES	No	---	---	No
Zinc	11,000	Subsurface	4,200	YES	No	---	---	No
Nitrate	11.4	Surface	2	YES	No	---	---	No
1,3,5-Trinitrobenzene	17	Subsurface	0.00073[g]	YES	YES	.000094	.00018	No
2,4-Dinitrotoluene	34	Surface	0.02	YES	YES	1.764	.0073	YES
2,4,6-Trinitrotoluene	16	Subsurface	0.053[g]	YES	No	----	---	No
2,6-Dinitrotoluene	0.78	Surface	0.01	YES	YES	.040	.0037	YES
Bis(2-ethylhexyl)phthalate	1.1	Subsurface	11	No	No	---	---	No
Butyl benzyl phthalate	0.31	Surface	6.8	No	No	---	---	No

Table 5-11. Selection of COPCs for Groundwater Exposure Pathways (SMWU 6) (continued)

Chemical	Maximum Above Background	Depth	Soil-to-GW[b] RBC[c] (mg/g)	Selected for Vadose Zone Modeling?	Reached Water Table Within 100 Years	Model Output: Break-Through Point Concentration in Groundwater	Tap Water RBC (mg/L)[d]	Selected as COPC[e] for Groundwater[f]?
Di-n-butyl phthalate	0.21	Surface	12.0	No	No	---	---	No
N-nitroso-diphenylamine	0.1	Subsurface	0.2	No	No	---	---	No
RDX	9.41	Subsurface	0.002	YES	YES	0.6098	.0006[a]	YES

Note.—RBCs were taken directly from the Region III RBC Table except as indicated in the footnotes.
[a]Micrograms per gram.
[b]Groundwater.
[c]Risk-based concentrations.
[d]Values obtained from Table 5-12.
[e]Chemicals of potential concern.
[f]Chemical was eliminated as a groundwater COPC if it reached the water table in over 100 years or did not exceed the tap water RBC.
[g]Calculated according to Region III guidance (USEPA 1995).
[h]Not applicable; vadose zone modeling showed that the chemical break-through time to the water table is greater than 100 years.

vadose-saturated zone modeling results were compared to the Region III tap water RBCs, with one-tenth for noncarcinogens. If the chemical still failed to meet the 100-year break-through criteria *and* exceeded the Region III tap water RBC, it was retained for quantitative risk assessment. As shown in Table 5-11, aluminum, arsenic, barium, boron, cadmium, chromium, copper, fluoride, lead, mercury, nickel, thallium, vanadium, zinc, 1,3,5-trinitrobenzene, 2,4-dinitrotoluene, 2,4,6-trinitrotoluene, 2,6-dinitrotoluene, RDX, and nitrate were retained for vadose zone modeling at SWMU 6.

5.1.4.2.1 ***Vadose Zone Model Results***. The soil screening described in the previous sections indicated that 21 COPCs should be evaluated using the soil-vadose-zone-groundwater-screening model at SWMU 6. These COPCs consist of the 16 metals and 5 explosive compounds indicated in Table 5-11. The vadose-zone modeling set-up procedures are described in detail in Section 2.7.2 of this report. This section defines the site-specific parameters and presents the vadose-zone modeling results.

The SWMU 6 site-specific input parameters are defined as the thickness of the vadose zone (H cm), the area of contamination (CA m^2), and the thickness of the contaminated zone (H cont, cm). These input parameters, along with the COPC chemical-specific parameters are used as the input for the GWM-1 and MULTIMED models. The GWM-1 spreadsheets for SWMU 6 are shown in Appendix K. The above site-specific parameters for SWMU 6 are as follows:

H = 8,200 cm

CA = 126,300 m^2

H cont = 365 cm

Other key COPC-specific parameters—the distribution coefficient (Kd), the maximum observed soil concentration (Tc), the initial pore water concentration (C_{init}), and the plume pulse duration (p.d.)—are also shown in Appendix K. All of the GWM-1 spreadsheets associated with the 21 SWMU-specific COPCs are in Appendix K. Table 5-12 summarizes these COPC-specific parameters and shows the MULTIMED output for COPC break-through time (time after leaching starts, that the leading edge of the COPC plume reaches the top of the water table) along with the COPC estimated concentration at the time that breakthrough occurs. One key to interpreting these estimates is that the pore water concentration was determined by starting with the maximum observed soil concentration measured at the SWMU (see Table 5-11) and calculating the maximum concentration available for the pore water solution by soil-water partitioning. As explained in Section 2.7, the equation used is very dependent on Kd and does not take into account mineral solubility and equilibrium relationships. This is evident by some of the high C_{init} concentrations estimated for several of the COPCs.

5.1.4.2.2 ***Groundwater COPCs***. As shown in the previous sections and in Table 5-11, the MULTIMED output indicates that within a 100-year time period only RDX, 1,3,5-trinitrobenzene, 2,4-dinitrotoluene, and 2,6-dinitrotoluene will travel downward through the

Table 5-12. Summary of Critical I/O GWM-1 and MULTIMED Parameters for SWMU 6

COPC[a] Specific Parameters						
Analyte	Kd[b]	Tc[c] (max) (ppm)[d]	C_{init}[e] (mg/L)[f]	Breakthrough Time (yrs)	Breakthrough Conc. (mg/L)	p.d.[g] (yrs)
Aluminum	1500	28100	20.8	>91000	ND[h]	94274
Antimony	45	60.6	1.5	28000	0.071	2835
Arsenic	1	95.2	95.2	650	0.809	70
Barium	52	2300	42.5	32000	1.76	3778
Boron	3	21.7	7.75	1850	0.084	195
Cadmium	1.3	46.5	36.6	850	1.19	89
Chromium	1.2	220	186	800	8.6	82
Copper	1.4	10000	735	900	14.9	95
Fluoride	1	12.4	12.4	653	0.161	70
Lead	4.5	17000	4100	2800	117	290
Mercury	10	0.706	0.078	6000	0.0003	635
Nickel	150	110	0.081	89000	0.00007	9434
Nitrate	1	11.4	11.4	653	0.148	70
Thallium	3200	347	0.12	ND	ND	201111
Vanadium	1000	34.8	0.039	ND	ND	62852
Zinc	1	11000	11000	650	93.5	70
1,3,5-Trinitrobenzene	1	17	17	83	0.00009	70
2,4,6-Trinitrotoluene	1	16	16	378	0.00013	70
2,4-Dinitrotoluene	1	34	34	73	1.764	70
2,6-Dinitrotoluene	1	0.78	0.78	73	0.04	70
RDX	1	9.41	9.41	58	0.6098	70

Note.—Site-specific parameters are as follows: vadose zone thickness (H) = 8,200 cm; area of contaminated soil (CA) = 126,300 m^2; thickness of contaminated soil (Hcont) = 365 cm.

[a]Chemicals of potential concern.
[b]Distribution coefficient and is dimensionless.
[c]Maximum observed soil concentration (ppm).
[d]Parts per million.
[e]Pore water concentration at the source as conservatively calculated by GWM-1.
[f]Milligrams per liter.
[g]Pulse duration as calculated by GWM-1.
[h]Not determined.

vadose zone and reach the water table. No other COPCs reach the water table within this period. As discussed in detail in Section 2.7.2, the conservative approach was the basis for the model calculations.

Table 5-12 illustrates this concept, showing the critical input and output parameters and the estimated break-through time for each COPC. This table also shows the estimated concentration associated with the arrival of the leading edge of the COPC plume at the water table. Again, it should be noted that the break-through time calculation does not take into account the various retardation influences, such as biodegradation, volatilization, absorption, and mineral-solution equilibrium.

The explosive compounds RDX, 1,3,5-trinitrobenzene, 2,4-dinitrotoluene, and 2,6-dinitrotoluene reach the water table in approximately 58, 83, 73, and 73 years, respectively. Additionally, MULTIMED calculations show that aluminum, thallium, and vanadium should not contact the water table until sometime after 90,000 years (MULTIMED is limited to 99,999 years for the transient simulation). The remainder of the COPCs—2,4,6-trinitrotoluene, arsenic, barium, cadmium, chromium, copper, mercury, lead, and nickel—ranged in break-through time from approximately 378 years for 2,4,6-trinitrotoluene to 89,000 years for nickel. Table 5-12 summarizes all 21 of the COPCs at SWMU 6. Appendix K shows an example of the time versus COPC concentration MULTIMED output for the various time steps in the arsenic simulation.

To further evaluate the potential for RDX, 1,3,5-trinitrobenzene, 2,4-dinitrotoluene, and 2,6-dinitrotoluene to affect human health, the saturated zone model was expanded to estimate the maximum on-site COPC concentration and the maximum off-site concentration at a hypothetical receptor on the northern boundary of TEAD-N (see Figure 2-4). Various input parameters were adjusted to accommodate the saturated zone modeling to the on-site and off-site receptors. These parameters included the aquifer thickness (50 meters), the mixing zone thickness (50 meters), and the initial pore water concentration (set equal to the average observed soil concentration). In addition, the hydraulic gradient and distance to the off-site receptor were adjusted to represent simulation to the hypothetical receptors of SWMU 6 to 0.006 (dimensionless) and 8,070 meters, respectively (see Section 2.7.2). The remaining input parameters were not adjusted. The hydraulic gradient, distance to the off-site receptor, and the modeling results are presented in Table 5-13. The on-site receptor was set to 1 meter from the point that the COPC first reached the water table, thus representing the saturated zone directly underlying the SWMU. Based on the modeling results (Table 5-13), 1,3,5-trinitrobenzene did not exceed the tap water RBC (Table 5-11) and was eliminated as a groundwater COPC. However, RDX, 2,4-dinitrotoluene, and 2,6-dinitrotoluene were carried on to the quantitative risk assessment for the future on-site adult resident.

5.1.4.3 *Exposure Pathway Assessment*

Exposure is defined as the contact of a receptor with a chemical (USEPA 1989c). Exposure assessment is the estimation of the magnitude, frequency, and duration for each identified

Table 5-13. *Summary of Vadose Zone and Saturated Zone Modeling for SWMU 6*
(Using Average Soil Concentrations)

SWMU	Chemical	Tc (avg) ppm	Cinit (mg/L)	Est. Peak On Site Conc. (mg/L)	Est. Peak On Site Time (yrs)	Est. Peak Off Site Conc. (mg/L)	Est. Peak Off Site Time (yrs.)	Est. Hydraulic Gradient	Est. Contaminated Area (m^2)	Est. Distance to Receptor (m)
6	RDX	0.7	0.7	0.0334	123	0.000102	603	0.006	126300	8070
6	1,3,5-TNB	0.62	0.62	0.1727	153	0.0000906	643	0.006	126300	8070
6	2,4-DNT	1.7	1.7	0.497	133	0.000249	643	0.006	126300	8070
6	2,6-DNT	0.3	0.3	0.0877	133	0.0000439	643	0.006	126300	8070

route of exposure. The magnitude of an exposure is determined by estimating the amount of chemical available at the receptor exchange boundaries (i.e., lungs, gastrointestinal tract, or skin) during a specified time period.

Section 3.1.2 describes the general tasks comprising the exposure assessment. The specific application of these tasks to SWMU 6 is described below.

5.1.4.3.1 ***Characterization of Exposure Setting.*** The first step in developing exposure scenarios for SWMU 6 was to characterize the site setting in which potential exposures might occur. The characteristics of the site setting influence the types of transport mechanisms and the type of receptor exposure that could occur. The site setting also provides a basis for identifying the potential receptors (either real or, in the case of site redevelopment for alternative use, hypothetical). Both current land use patterns and future land use patterns were examined as part of the characterization.

Current Land Use. As is true for other areas of TEAD-N, public access to SWMU 6 is controlled, thereby precluding transient exposure. SWMU 6 is located in the south-central portion of TEAD-N and will remain part of the depot mission for the foreseeable future. Data were not available on current use patterns of the Old Burn Area.

Based on the above information, potential receptors under current land use were defined as:

- SWMU-specific laborers and security personnel—Individuals with job descriptions that call for repeated, light to moderate labor in the general vicinity of SWMU 6 and staff assigned to maintenance of the perimeter or security personnel that repeatedly work in the vicinity of SWMU 6.

- Off-site residents—Military personnel and/or civilians living near the depot perimeter.

Because these other potential receptors would be exposed only intermittently to SWMU 6, SWMU-specific laborers and security personnel were the only on-site receptors evaluated quantitatively as a current-use scenario. This approach provides a series of upper-bound estimates. Off-site residents living near the depot boundary may potentially be exposed to SWMU-related chemicals bound to resuspended particulate. Therefore, the inhalation pathway is quantitatively evaluated for these receptors.

Cattle grazing is permitted at TEAD-N, with grazing allotments competitively bid and leased every 5 years to a single rancher. The current lease is up for rebid in 1996. Grazing at TEAD-N typically occurs between October 15 and May 31, with calving taking place in January. The calves remain at the facility until May 31 when they are either moved to feedlots or to other grazing areas. The calves typically do not return to TEAD-N after their initial exposure, and they are eventually sold as slaughter cattle for human consumption. Distribution is through regional and national distribution networks. The cows are normally utilized as breeding stock and may or may not return to the site during consecutive years. The

current lessee brings approximately 1,000 head, mostly heifers, to winter pasture at TEAD-N and maintains summer pasture in Idaho (M. Walker, personal communication with Rust E&I, 1994).

SWMU 6 is one of several SWMUs on one grazing allotment currently under lease. Consumption of beef grazed on the allotment of which SWMU 6 is evaluated in a separate section (Section 5.7) of the risk assessment.

Future Land Use. No change in current use is planned for the Old Burn Area; therefore, some exposure scenarios that are analogous to current-use scenarios described above will continue (e.g., SWMU-specific laborers and security personnel). Current BRAC recommendations retain SWMU 6's function as part of the depot's mission. However, should the mission of TEAD-N change in the future, two additional exposure scenarios unique to planned or potential future use of SWMU 6 were developed.

- Skilled laborers—Individuals assigned to short-term construction in the vicinity of SWMU 6 during potential redevelopment.

- Inhabitants of an on-site residence(s)—Individuals who live in residences established at the time that depot property should ever be transferred for redevelopment.

5.1.4.3.2 ***Characterization of Potential Exposure Pathways***. An exposure pathway is the route COPCs take to reach potential receptors. Section 3.1.2.1 and 3.1.2.2 describe the methodology for characterization of exposure pathways. This methodology was then applied to SWMU 6. The following sections describe the potential exposure pathways associated with SWMU 6 for the current and future land use scenarios.

Current Land Use. Currently, the majority of laborers at TEAD-N work 10-hour days with 4-day weeks. A total of 4 weeks off a year for vacation, holidays, and sick leave yields 192 days per year on the job. It is assumed that a laborer could be at any specific SWMU from 2 (CTE) to 10 (RME) hours per day and will incidentally ingest, inhale, or become in contact with surface soil through worker-related activities. Military personnel are rotated on assignment an average of every 3 years (S. Culley, personal communication with Rust E&I, 1994). If a laborer is a civilian, the length of assignment could be expected to range as high as 25 years. It is assumed that all of the exposure is from outdoor tasks or activities. Specific parameters relating to ingestion, contact, and ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

For the current off-site adult resident, it was assumed that at least one parent would spend much of his or her time away from home in activities such as working at another location, household errands, personal care (e.g., medical/dental appointments), or leisure activities. Based on this assumption, the total estimated time an adult spends at home is approximately 15 to 19 hours per day, during which time he or she may inhale particulates generated from surface soil associated with SWMU 6 while conducting activities such as gardening, mowing,

or outdoor sports. For children ages 0 to 18, time activity patterns indicate that they spend an average of approximately 30 hours per week away from home to attend school or day care. The total time a child spends at home averaged over a 7-day week is 20 hours per day. It is assumed that residents spend 2 (RME) to 4 (CTE) weeks away from home on vacation or long holiday weekends. Therefore, the exposure frequency in real time is 335 days per year (CTE) to 350 days per year (RME). Because the contact rate for ingestion and dermal exposure is in daily units, the exposure frequency for these pathways is prorated into 24-hour-day equivalents. This ranges from 216 (CTE adult) to 276 days per year (CTE child) and 273 (RME adult) to 288 days per year (RME child) (see Appendix L). Years spent at one residence for the adult/child range from 8 (CTE) to 30 (RME) years based on studies compiled by the USEPA (1989c) and AIHC (1994). Specific parameters relating to ventilation rates, body weights, and bioavailability are given in Appendix L.

Future Land Use. Based on the future usage of SWMU 6, it is possible that industrial construction may be conducted to increase the capacity of the military operations at TEAD-N. For these reasons, the future construction worker scenario was evaluated. It is assumed that a construction company could be contracted for a work period ranging from 1 to 3 years and a single worker could be at the site conducting activities outdoors from 2 to 4 months of the year. It is assumed that a worker works as much as 8 to 10 hours per day and may incidentally ingest, inhale, or come in contact with subsurface soil through construction-related activities. Specific parameters relating to ingestion, contact, ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

Should the future planned use of SWMU 6 change and the property be zoned for potential residential development, the future on-site adult and child resident are also evaluated for the future land use scenario. For the future on-site adult resident, it was assumed that at least one parent would spend much of his or her time away from home in activities such as working at another location, household errands, personal care (e.g., medical/dental appointments), or leisure activities. Based on this assumption, the total estimated time an adult will spend at home is approximately 15 to 19 hours per day, during which time he or she may incidentally ingest, inhale, or come in contact with surface soil while conducting activities such as gardening, mowing, or outdoor sports. It is also expected that the future on-site resident will grow and harvest vegetables and fruits from a home garden. For children and adolescents ages 0 to 18, time activity patterns indicate that they spend an average of approximately 30 hours per week away from home to attend school or day care. The total time a child spends at home, averaged over a 7-day week, is approximately 20 hours per day. It is assumed that residents spend 2 (RME) to 4 (CTE) weeks away from home on vacation or long holiday weekends. Therefore, the exposure frequency in real time is 335 days per year (CTE) to 350 days per year (RME). Because the contact rate for ingestion and dermal exposure is in daily units, the exposure frequency for these pathways is prorated into 24-hour-day equivalents. This ranges from 216 days per year (CTE adult) to 276 days per year (CTE child) and from 273 days per year (RME adult) to 288 days per year (RME child) (see Appendix L). Years spent at one residence for the adult/child range from 8 (CTE) to 30 (RME) years based on studies compiled by the USEPA (1989c) and AIHC (1994). Specific parameters relating to ingestion, contact, ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

In addition to the pathways discussed above, for the potential on-site adult resident at SWMU 6, the ingestion of groundwater pathway was separately evaluated. It is assumed that adults drink between 1.4 to 2 liters per day of well water associated with SWMU 6. Other parameters such as exposure frequency, duration, and body weight are the same as discussed above.

5.1.4.4 *Exposure Point Concentrations*

The EPC is defined as the concentration of a COPC in an exposure medium that will be contacted over a real or hypothetical exposure duration. EPCs at SWMU 6 were evaluated for current and future land use. Estimation of EPCs is fully described in Appendix L. For brevity, only information specific to SWMU 6 is presented in the following sections.

As discussed in Sections 5.1.4.1 and 5.1.4.2, three areas of concern were evaluated for SWMU 6. Based on the screening methodology, EPCs were estimated for surface and/or subsurface soils for two areas of concern—Northeast Revetment Area and Hot Spot at Test Pit 3—as well as the remainder of the SWMU, not including the areas of concern and the SWMU as a whole.

Current Land Use. EPCs for surface soil ingestion and dermal contact by the SWMU 6 personnel were estimated for the CTE and RME exposure scenario from Phase I and II RI data. Because the duties of on-site personnel vary, EPCs were developed for each area of concern and balance of area associated with the SWMU, as well as the SWMU as a whole to encompass all potential exposure scenarios for this receptor.

EPCs in air for on-site personnel and off-site residents were estimated using USEPA's SCREEN2 model. Air emissions were not evaluated for each specific area of concern. It was assumed that the SWMU, as a whole, was the main source for air emission generation for all on- and off-site receptors. Details of the estimation of emission rates from surface soils and dispersion modeling are described in Appendix N. Tables 5-14 through 5-19 presents the EPCs for on-site personnel and off-site residents associated with SWMU 6.

Future Land Use. EPCs for subsurface soil ingestion and dermal contact by hypothetical future on-site construction workers at SWMU 6 were estimated using the same methods as those used for the on-site personnel under the current land use scenario. However, it was assumed that the construction projects would be limited in size; therefore, potential exposure pathways are not evaluated for the SWMU as a whole but are limited to the specific areas of concern (Tables 5-14 through 5-16). EPCs for inhalation of particulates were modeled, as described in Appendix N, for the hypothetical future on-site construction worker and resident (see Appendix L).

EPCs for surface soil ingestion, dermal contact with surface soil, ingestion of produce, and ingestion of groundwater (adults only) by hypothetical future on-site residents at SWMU 6 were estimated using methods described in Appendix L. The EPCs are given in Tables 5-14 through 5-19.

Table 5-14. Adult Exposure Point Concentrations for Northeast Revetment Area of Concern Associated with SWMU 6

Chemical	Exposure Point Concentration	
	CTE	RME
Current Land Use		
Surface Soil (mg/kg)		
Arsenic	15.8	15.8
Copper	1,270	1,270
Lead	503	503
Air (μg/m³)		
Arsenic	0.00076	0.00076
Copper	0.0039	0.0039
Lead	0.0046	0.0046
Future Land Use [a]		
Surface Soil (mg/kg)[b]		
Air [Particulates associated with Surface Soil] (μg/m³)[b]		
Subsurface Soil (mg/kg)		
Aluminum	13,894	13,894
Antimony	22.4	22.4
Arsenic	22.3	22.3
Chromium	46.3	46.3
Copper	593	593
Iron	53,680	53,680
Lead	262	262
Thallium	46.4	46.4
Zinc	5,169	5,169
Air [Particulates associated with Subsurface Soil] (μg/m³)		
Aluminum	53.9	53.9
Antimony	0.087	0.087
Arsenic	0.086	0.086
Chromium	0.18	0.18
Copper	2.3	2.3
Iron	208	208
Lead	1.02	1.02
Thallium	0.18	0.18
Zinc	20	20
Tubers/Fruits (mg/kg)		
Arsenic	0.021	0.021
Copper	69.9	69.9
Lead	1.0	1.0
Leafy Vegetables (mg/kg)		
Arsenic	0.044	0.044
Copper	35.6	35.6
Lead	1.58	1.58

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.
[b]Future use concentrations are the same as for the current use scenarios.

Table 5-15. Child Exposure Point Concentrations for Northeast Revetment Area of Concern Associated with SWMU 6

Chemical	Exposure Point Concentration	
	CTE	**RME**
Future Land Use [a]		
Surface Soil (mg/kg)		
Arsenic	15.8	15.8
Copper	1,270	1,270
Lead	503	503
Air ($\mu g/m^3$)		
Arsenic	0.00076	0.00076
Copper	0.0039	0.0039
Lead	0.0046	0.0046
Tubers/Fruits (mg/kg)		
Arsenic	0.021	0.021
Copper	69.9	69.9
Lead	1.0	1.0
Leafy Vegetables (mg/kg)		
Arsenic	0.044	0.044
Copper	35.6	35.6
Lead	1.58	1.58

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Table 5-16. Adult Exposure Point Concentrations for Hot Spot at Test Pit 3 Area of Concern Associated with SWMU 6

	Exposure Point Concentration	
Chemical	**CTE**	**RME**
Future Land Use [a]		
Subsurface Soil (mg/kg)		
1,3,5-Trinitrobenzene	17.0	17.0
Air [Particulates associated with Subsurface Soil] ($\mu g/m^3$)		
1,3,5-Trinitrobenzene	0.066	0.066

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Table 5-17. Adult Exposure Point Concentrations for Remainder of SWMU 6 Outside Areas of Concern

	Exposure Point Concentration	
Chemical	**CTE**	**RME**
Current Land Use		
Surface Soil (mg/kg)		
Arsenic	11.9	11.9
Air ($\mu g/m^3$)		
Arsenic	0.00076	0.00076
Copper	0.0039	0.0039
Lead	0.0046	0.0046
Future Land Use [(a)]		
Surface Soil (mg/kg)[(b)]		
Air [Particulates associated with Surface Soil] ($\mu g/m^3$)[(b)]		
Tubers/Fruits (mg/kg)		
Arsenic	0.016	0.016
Leafy Vegetables (mg/kg)		
Arsenic	0.033	0.033
Groundwater (mg/L)		
RDX	.033	.033
1,3,5-Trinitrobenzene	0.17	0.17
2,4-Dinitrotoluene	0.50	0.50
2,6-Dinitrotoluene	0.09	0.09

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.
[b]Future use concentrations are the same as for the current use scenarios.

Table 5-18. Child Exposure Point Concentrations for Remainder of SWMU 6 Outside Areas of Concern

	Exposure Point Concentration	
Chemical	**CTE**	**RME**
Future Land Use [a]		
Surface Soil (mg/kg)[b]		
Arsenic	11.9	11.9
Air ($\mu g/m^3$)[b]		
Arsenic	0.00076	0.00076
Copper	0.0039	0.0039
Lead	0.0046	0.0046
Tubers/Fruits (mg/kg)		
Arsenic	0.016	0.016
Leafy Vegetables (mg/kg)		
Arsenic	0.033	0.033

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Table 5-19. Adult Exposure Point Concentrations for SWMU 6 as a Whole

	Exposure Point Concentration	
Chemical	**CTE**	**RME**
Current Land Use		
Surface Soil (mg/kg)		
Arsenic	15.0	15.0
Copper	77.8	77.8
Lead	90.4	90.4
On-site Air ($\mu g/m^3$)		
Arsenic	0.00076	0.00076
Copper	0.0039	0.0039
Lead	0.0046	0.0046
Off-site Air ($\mu g/m^3$)[a]		
Arsenic	0.00065	0.00065
Copper	0.0034	0.0034
Lead	0.0039	0.0039

[a]Exposure point concentrations are the same for the child resident and the adult resident.

5.1.4.4.1 *Estimation of Chemical Intakes.* The exposure models described in detail in Appendix L together with EPCs listed in Tables 5-14 through 5-19 were used to estimate intake for the potential exposure scenarios. Note that averaging time differs for carcinogens and noncarcinogens. Estimates of exposure intakes are given in Tables 5-20 through 5-40 in the following sections.

5.1.4.5 *Toxicity Assessment*

Information on the toxicological effects of carcinogenic and systemic toxicants are summarized in Appendix M. This toxicity assessment includes brief toxicity profiles on data listed in USEPA's IRIS database and published in HEAST (USEPA 1994c). These profiles describe the acute, chronic, and carcinogenic health effects associated with SWMU-related chemicals. Toxicity values for COPCs associated with SWMU 6 are summarized in Tables 5-20 through 5-40.

5.1.4.6 *Risk Characterization*

This section provides a characterization of the potential health risks using the intake of chemicals associated with two areas of concern associated with SWMU 6—Northeast Revetment Area and Hot Spot at Test Pit 3. In addition, potential risks were evaluated for the remainder of SWMU 6 not including the areas of concern and SWMU 6 as a whole. The risk characterization compares estimated potential ILCRs with reasonable levels of risk for potential carcinogens (see Section 3.1.4.1), and the estimated daily intake of systemic toxicants with appropriate reference levels. Some carcinogenic chemicals may also pose a systemic hazard, and these potential hazards are characterized as for other systemic toxicants. Each of the areas associated with SWMU 6 are discussed separately below.

5.1.4.6.1 *Characterization of Potential Carcinogenic Risks.* The USEPA currently classifies lead salts as probable human carcinogens (Class B2). However, quantifying lead's cancer risk involves many uncertainties, some of which may be unique to lead. Age, health, nutritional state, body burden, and exposure duration influence the absorption, release, and excretion of lead. In addition, current knowledge of lead pharmacokinetics indicates that an estimate derived by standard procedures would not truly describe the potential risk. Thus, the USEPA's Carcinogen Assessment Group recommends that a numerical estimate not be used (USEPA 1995a).

Northeast Revetment Area of Concern. The general process used to select the COPCs associated with the Northeast Revetment area of concern is described in Section 3.1.1. COPC selection for SWMU 6 is described in Section 5.1.4.2. For current and future land use scenarios, aluminum, antimony, arsenic, chromium, copper, iron, lead, thallium and zinc were identified as COPCs. Arsenic and chromium, known human carcinogens, are the only COPCs that contribute to the carcinogenic risk. Tables 5-14 and 5-15 list the COPCs and their associated media.

Table 5-20. Summary of Potential Carcinogenic Risk Results for the Current/Future On-Site Laborer for SWMU 6 (Northeast Revetment Area)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.6E+01	1.5E-09	1.5E+00	2.3E-09	
Copper	1.3E+03	NA(d)	NA	NA	
Lead	5.0E+02	NA	NA	NA	
			Pathway Total:	2.3E-09	78%
Dermal Contact with Surface Soil					
Arsenic	1.6E+01	7.5E-11	1.5E+00	1.2E-10	
Copper	1.3E+03	NA	NA	NA	
Lead	5.0E+02	NA	NA	NA	
			Pathway Total:	1.2E-10	4%
Inhalation of Particulates					
Arsenic	7.6E-07	3.5E-11	1.5E+01	5.2E-10	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	5.2E-10	18%
			Total CTE ILCR:	2.9E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.6E+01	1.2E-06	1.5E+00	1.8E-06	
Copper	1.3E+03	NA	NA	NA	
Lead	5.0E+02	NA	NA	NA	
			Pathway Total:	1.8E-06	84%
Dermal Contact with Surface Soil					
Arsenic	1.6E+01	1.4E-07	1.5E+00	2.1E-07	
Copper	1.3E+03	NA	NA	NA	
Lead	5.0E+02	NA	NA	NA	
			Pathway Total:	2.1E-07	10%
Inhalation of Particulates					
Arsenic	7.6E-07	8.3E-09	1.5E+01	1.2E-07	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	1.2E-07	6%
			Total RME ILCR:	2.1E-06	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-21. Summary of Potential Carcinogenic Risk Results for the Future On-Site Adult Resident for SWMU 6 (Northeast Revetment Area)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] (mg/kg-day)$^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.6E+01	1.4E-07	1.5E+00	2.1E-07	
Copper	1.3E+03	NA[d]	NA	NA	
Lead	5.0E+02	NA	NA	NA	
			Pathway Total:	2.1E-07	7%
Dermal Contact with Surface Soil					
Arsenic	1.6E+01	6.9E-09	1.5E+00	1.1E-08	
Copper	1.3E+03	NA	NA	NA	
Lead	5.0E+02	NA	NA	NA	
			Pathway Total:	1.1E-08	0%
Inhalation of Particulates					
Arsenic	7.6E-07	2.7E-09	1.5E+01	4.1E-08	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	4.1E-08	1%
Ingestion of Leafy Vegetables					
Arsenic	4.4E-02	6.6E-07	1.5E+00	9.9E-07	
Copper	3.6E+01	NA	NA	NA	
Lead	1.6E+01	NA	NA	NA	
			Pathway Total:	9.9E-07	35%
Ingestion of Tubers and Fruits					
Arsenic	2.1E-02	1.0E-06	1.5E+00	1.6E-06	
Copper	7.0E+01	NA	NA	NA	
Lead	1.0E+00	NA	NA	NA	
			Pathway Total:	1.6E-06	56%
			Total CTE ILCR:	2.8E-06	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.6E+01	3.3E-06	1.5E+00	4.9E-06	
Copper	1.3E+03	NA	NA	NA	
Lead	5.0E+02	NA	NA	NA	
			Pathway Total:	4.9E-06	13%
Dermal Contact with Surface Soil					
Arsenic	1.6E+01	3.8E-07	1.5E+00	5.9E-07	
Copper	1.3E+03	NA	NA	NA	
Lead	5.0E+02	NA	NA	NA	
			Pathway Total:	5.9E-07	1%
Inhalation of Particulates					
Arsenic	7.6E-07	1.4E-08	1.5E+01	2.2E-07	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	2.2E-07	1%
Ingestion of Leafy Vegetables					
Arsenic	4.4E-02	8.7E-06	1.5E+00	1.3E-05	
Copper	3.6E+01	NA	NA	NA	
Lead	1.6E+01	NA	NA	NA	
			Pathway Total:	1.3E-05	33%
Ingestion of Tubers and Fruits					
Arsenic	2.1E-02	1.4E-05	1.5E+00	2.1E-05	
Copper	7.0E+01	NA	NA	NA	
Lead	1.0E+00	NA	NA	NA	
			Pathway Total:	2.1E-05	52%
			Total RME ILCR:	3.9E-05	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-22. Summary of Potential Carcinogenic Risk Results for the Future On-Site Child Resident for SWMU 6 (Northeast Revetment Area)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] (mg/kg-day)$^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.6E+01	6.3E-07	1.5E+00	9.4E-07	
Copper	1.3E+03	NA[d]	NA	NA	
Lead	5.0E+02	NA	NA	NA	
			Pathway Total:	9.4E-07	18%
Dermal Contact with Surface Soil					
Arsenic	1.6E+01	1.2E-08	1.5E+00	1.8E-08	
Copper	1.3E+03	NA	NA	NA	
Lead	5.0E+02	NA	NA	NA	
			Pathway Total:	1.8E-08	0%
Inhalation of Particulates					
Arsenic	7.6E-07	1.4E-08	1.5E+01	2.1E-07	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	2.1E-07	4%
Ingestion of Leafy Vegetables					
Arsenic	4.4E-02	1.1E-06	1.5E+00	1.6E-06	
Copper	3.6E+01	NA	NA	NA	
Lead	1.6E+00	NA	NA	NA	
			Pathway Total:	1.6E-06	30%
Ingestion of Tubers and Fruits					
Arsenic	2.1E-02	1.7E-06	1.5E+00	2.6E-06	
Copper	7.0E+01	NA	NA	NA	
Lead	1.0E+00	NA	NA	NA	
			Pathway Total:	2.6E-06	48%
			Total CTE ILCR:	5.3E-06	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.6E+01	7.0E-06	1.5E+00	1.0E-05	
Copper	1.3E+03	NA	NA	NA	
Lead	5.0E+02	NA	NA	NA	
			Pathway Total:	1.0E-05	32%
Dermal Contact with Surface Soil					
Arsenic	1.6E+01	1.6E-07	1.5E+00	2.4E-07	
Copper	1.3E+03	NA	NA	NA	
Lead	5.0E+02	NA	NA	NA	
			Pathway Total:	2.4E-07	1%
Inhalation of Particulates					
Arsenic	7.6E-07	2.3E-08	1.5E+01	3.4E-07	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	3.4E-07	1%
Ingestion of Leafy Vegetables					
Arsenic	4.4E-02	5.7E-06	1.5E+00	8.6E-06	
Copper	3.6E+01	NA	NA	NA	
Lead	1.6E+00	NA	NA	NA	
			Pathway Total:	8.6E-06	26%
Ingestion of Tubers and Fruits					
Arsenic	2.1E-02	9.0E-06	1.5E+00	1.4E-05	
Copper	7.0E+01	NA	NA	NA	
Lead	1.0E+00	NA	NA	NA	
			Pathway Total:	1.4E-05	41%
			Total RME ILCR:	3.3E-05	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-23. Summary of Potential Carcinogenic Risk Results for the Future Construction Worker for SWMU 6 (Northeast Revetment Area)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) (mg/kg-day)-1	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Subsurface Soil					
Aluminum	1.4E+04	NA(d)	NA	NA	
Antimony	2.2E+01	NA	NA	NA	
Arsenic	2.2E+01	1.6E-07	1.5E+00	2.4E-07	
Chromium	4.6E+01	NA	NA	NA	
Copper	5.9E+02	NA	NA	NA	
Iron	5.4E+04	NA	NA	NA	
Lead	2.6E+02	NA	NA	NA	
Thallium	4.6E+01	NA	NA	NA	
Zinc	5.2E+03	NA	NA	NA	
			Pathway Total:	2.4E-07	22%
Dermal Contact with Subsurface Soil					
Aluminum	1.4E+04	NA	NA	NA	
Antimony	2.2E+01	NA	NA	NA	
Arsenic	2.2E+01	5.8E-10	1.5E+00	8.9E-10	
Chromium	4.6E+01	NA	NA	NA	
Copper	5.9E+02	NA	NA	NA	
Iron	5.4E+04	NA	NA	NA	
Lead	2.6E+02	NA	NA	NA	
Thallium	4.6E+01	NA	NA	NA	
Zinc	5.2E+03	NA	NA	NA	
			Pathway Total:	8.9E-10	0%
Inhalation of Particulates					
Aluminum	5.4E-02	NA	NA	NA	
Antimony	8.7E-05	NA	NA	NA	
Arsenic	8.6E-05	8.4E-09	1.5E-01	1.3E-07	
Chromium	1.8E-04	1.7E-08	4.2E+01	7.3E-07	
Copper	2.3E-03	NA	NA	NA	
Iron	2.1E-01	NA	NA	NA	
Lead	1.0E+00	NA	NA	NA	
Thallium	1.8E-04	NA	NA	NA	
Zinc	2.0E-02	NA	NA	NA	
			Pathway Total:	8.6E-07	78%
			Total CTE ILCR:	1.1E-06	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Subsurface Soil					
Aluminum	1.4E+04	NA	NA	NA	
Antimony	2.2E+01	NA	NA	NA	
Arsenic	2.2E+01	2.3E-06	1.5E+00	3.4E-06	
Chromium	4.6E+01	NA	NA	NA	
Copper	5.9E+02	NA	NA	NA	
Iron	5.4E+04	NA	NA	NA	
Lead	2.6E+02	NA	NA	NA	
Thallium	4.6E+01	NA	NA	NA	
Zinc	5.2E+03	NA	NA	NA	
			Pathway Total:	3.4E-06	23%
Dermal Contact with Subsurface Soil					
Aluminum	1.4E+04	NA	NA	NA	
Antimony	2.2E+01	NA	NA	NA	
Arsenic	2.2E+01	4.0E-08	1.5E+00	6.2E-08	
Chromium	4.6E+01	NA	NA	NA	
Copper	5.9E+02	NA	NA	NA	
Iron	5.4E+04	NA	NA	NA	
Lead	2.6E+02	NA	NA	NA	
Thallium	4.6E+01	NA	NA	NA	
Zinc	5.2E+03	NA	NA	NA	
			Pathway Total:	6.2E-08	0%
Inhalation of Particulates					
Aluminum	5.4E-02	NA	NA	NA	
Antimony	8.7E-05	NA	NA	NA	
Arsenic	8.6E-05	1.1E-07	1.5E+01	1.7E-06	
Chromium	1.8E-04	2.3E-07	4.2E+01	9.6E-06	
Copper	2.3E-03	NA	NA	NA	
Iron	2.1E-01	NA	NA	NA	
Lead	1.0E+00	NA	NA	NA	
Thallium	1.8E-04	NA	NA	NA	
Zinc	2.0E-02	NA	NA	NA	
			Pathway Total:	1.1E-05	76%
			Total RME ILCR:	1.5E-05	100%

(a) Units for the inhalation pathway are mg/m^3.
(b) See Appendix L for sources and methodology on estimating a daily intake value.
(c) See Appendix M for sources and methodology of toxicity values.
(d) NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-24. Summary of Potential Carcinogenic Risk Results for the Current/Future On-Site Laborer for SWMU 6 (Remainder of Site)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.2E+01	1.1E-09	1.5E+00	1.7E-09	
			Pathway Total:	1.7E-09	74%
Dermal Contact with Surface Soil					
Arsenic	1.2E+01	5.7E-11	1.5E+00	8.7E-11	
			Pathway Total:	8.7E-11	4%
Inhalation of Particulates					
Arsenic	7.6E-07	3.5E-11	1.5E+01	5.2E-10	
Copper	3.9E-06	NA(d)	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	5.2E-10	22%
			Total CTE ILCR:	2.3E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.2E+01	9.1E-07	1.5E+00	1.4E-06	
			Pathway Total:	1.4E-06	83%
Dermal Contact with Surface Soil					
Arsenic	1.2E+01	1.1E-07	1.5E+00	1.6E-07	
			Pathway Total:	1.6E-07	10%
Inhalation of Particulates					
Arsenic	7.6E-07	8.3E-09	1.5E+01	1.2E-07	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	1.2E-07	8%
			Total RME ILCR:	1.6E-06	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-25. Summary of Potential Carcinogenic Risk Results for the Future On-Site Adult Resident for SWMU 6 (Remainder of Site)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.2E+01	1.0E-07	1.5E+00	1.6E-07	
			Pathway Total:	1.6E-07	7%
Dermal Contact with Surface Soil					
Arsenic	1.2E+01	5.2E-09	1.5E+00	8.0E-09	
			Pathway Total:	8.0E-09	0%
Inhalation of Particulates					
Arsenic	7.6E-07	2.7E-09	1.5E+01	4.1E-08	
Copper	3.9E-06	NA[d]	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	4.1E-08	2%
Ingestion of Leafy Vegetables					
Arsenic	3.3E-02	5.0E-07	1.5E+00	7.4E-07	
			Pathway Total:	7.4E-07	35%
Ingestion of Tubers and Fruits					
Arsenic	1.6E-02	7.9E-07	1.5E+00	1.2E-06	
			Pathway Total:	1.2E-06	55%
			Total CTE ILCR:	2.1E-06	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.2E+01	2.5E-06	1.5E+00	3.7E-06	
			Pathway Total:	3.7E-06	13%
Dermal Contact with Surface Soil					
Arsenic	1.2E+01	2.9E-07	1.5E+00	4.4E-07	
			Pathway Total:	4.4E-07	1%
Inhalation of Particulates					
Arsenic	7.6E-07	1.4E-08	1.5E+01	2.2E-07	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	2.2E-07	1%
Ingestion of Leafy Vegetables					
Arsenic	3.3E-02	6.5E-06	1.5E+00	9.8E-06	
			Pathway Total:	9.8E-06	33%
Ingestion of Tubers and Fruits					
Arsenic	1.6E-02	1.0E-05	1.5E+00	1.5E-05	
			Pathway Total:	1.5E-05	52%
			Total RME ILCR:	3.0E-05	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-26. Summary of Potential Carcinogenic Risk Results for the Future On-Site Child Resident for SWMU 6 (Remainder of Site)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.2E+01	4.7E-07	1.5E+00	7.1E-07	
			Pathway Total:	7.1E-07	17%
Dermal Contact with Surface Soil					
Arsenic	1.2E+01	8.8E-09	1.5E+00	1.3E-08	
			Pathway Total:	1.3E-08	0%
Inhalation of Particulates					
Arsenic	7.6E-07	1.4E-08	1.5E+01	2.1E-07	
Copper	3.9E-06	NA[d]	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	2.1E-07	5%
Ingestion of Leafy Vegetables					
Arsenic	3.3E-02	8.1E-07	1.5E+00	1.2E-06	
			Pathway Total:	1.2E-06	30%
Ingestion of Tubers and Fruits					
Arsenic	1.6E-02	1.3E-06	1.5E+00	1.9E-06	
			Pathway Total:	1.9E-06	47%
			Total CTE ILCR:	4.1E-06	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.2E+01	5.3E-06	1.5E+00	7.9E-06	
			Pathway Total:	7.9E-06	32%
Dermal Contact with Surface Soil					
Arsenic	1.2E+01	1.2E-07	1.5E+00	1.8E-07	
			Pathway Total:	1.8E-07	1%
Inhalation of Particulates					
Arsenic	7.6E-07	2.3E-08	1.5E+01	3.4E-07	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	3.4E-07	1%
Ingestion of Leafy Vegetables					
Arsenic	3.3E-02	4.3E-06	1.5E+00	6.4E-06	
			Pathway Total:	6.4E-06	26%
Ingestion of Tubers and Fruits					
Arsenic	1.6E-02	6.8E-06	1.5E+00	1.0E-05	
			Pathway Total:	1.0E-05	41%
			Total RME ILCR:	2.5E-05	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-27. Summary of Potential Carcinogenic Risk Results for the Current/Future On-Site Laborer for SWMU 6 as a Whole

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.5E+01	1.4E-09	1.5E+00	2.1E-09	
Copper	7.8E+01	NA(d)	NA	NA	
Lead	9.0E+01	NA	NA	NA	
			Pathway Total:	2.1E-09	77%
Dermal Contact with Surface Soil					
Arsenic	1.5E+01	7.1E-11	1.5E+00	1.1E-10	
Copper	7.8E+01	NA	NA	NA	
Lead	9.0E+01	NA	NA	NA	
			Pathway Total:	1.1E-10	4%
Inhalation of Particulates					
Arsenic	7.6E-07	3.5E-11	1.5E+01	5.2E-10	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	5.2E-10	19%
			Total CTE ILCR:	2.8E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.5E+01	1.1E-06	1.5E+00	1.7E-06	
Copper	7.8E+01	NA	NA	NA	
Lead	9.0E+01	NA	NA	NA	
			Pathway Total:	1.7E-06	84%
Dermal Contact with Surface Soil					
Arsenic	1.5E+01	1.3E-07	1.5E+00	2.0E-07	
Copper	7.8E+01	NA	NA	NA	
Lead	9.0E+01	NA	NA	NA	
			Pathway Total:	2.0E-07	10%
Inhalation of Particulates					
Arsenic	7.6E-07	8.3E-09	1.5E+01	1.2E-07	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	1.2E-07	6%
			Total RME ILCR:	2.0E-06	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-28. Summary of Potential Carcinogenic Risk Results for the Current Off-Site Adult Resident for SWMU 6 as a Whole

Chemical	Exposure Point Concentration (mg/m^3)	Daily Carcinogenic Intake(a) (mg/kg-day)	Carcinogenic Slope Factor(b) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Inhalation of Particulates					
Arsenic	6.5E-07	2.4E-09	1.5E+01	3.5E-08	
Copper	3.4E-06	NA(c)	NA	NA	
Lead	3.9E-06	NA	NA	NA	
			Total CTE ILCR:	3.5E-08	100%
Reasonable Maximum Exposure (RME) Scenario					
Inhalation of Particulates					
Arsenic	6.5E-07	1.2E-08	1.5E+01	1.9E-07	
Copper	3.4E-06	NA	NA	NA	
Lead	3.9E-06	NA	NA	NA	
			Total RME ILCR:	1.9E-07	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.
[b]See Appendix M for sources and methodology of toxicity values.
[c]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-29. Summary of Potential Carcinogenic Risk Results for the Current Off-Site Child Resident for SWMU 6 as a Whole

Chemical	Exposure Point Concentration (mg/m^3)	Daily Carcinogenic Intake(a) (mg/kg-day)	Carcinogenic Slope Factor(b) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Inhalation of Particulates					
Arsenic	6.5E-07	1.2E-08	1.5E+01	1.8E-07	
Copper	3.4E-06	NA(c)	NA	NA	
Lead	3.9E-06	NA	NA	NA	
			Total CTE ILCR:	1.8E-07	100%
Reasonable Maximum Exposure (RME) Scenario					
Inhalation of Particulates					
Arsenic	6.5E-07	2.0E-08	1.5E+01	2.9E-07	
Copper	3.4E-06	NA	NA	NA	
Lead	3.9E-06	NA	NA	NA	
			Total RME ILCR:	2.9E-07	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.
[b]See Appendix M for sources and methodology of toxicity values.
[c]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-30. Summary of Carcinogenic Risk Results for the Ingestion of Groundwater Pathway by the Future On-Site Adult Resident for SWMU 6

Chemical	Exposure Point Concentration (mg/L)	Daily Carcinogenic Intake(a) (mg/kg-day)	Carcinogenic Slope Factor(b) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Groundwater					
RDX	3.3E-02	4.1E-05	1.1E-01	4.5E-06	
1,3,5-Trinitrobenzene	1.7E-01	NA(c)	NA	NA	
2,4-Dinitrotoluene	5.0E-01	6.1E-04	6.8E-01	4.2E-04	
2,6-Dinitrotoluene	8.8E-02	1.1E-04	6.8E-01	7.3E-05	
			Total CTE ILCR:	4.9E-04	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Groundwater					
RDX	3.3E-02	2.8E-04	1.1E-01	3.1E-05	
1,3,5-Trinitrobenzene	1.7E-01	NA	NA	NA	
2,4-Dinitrotoluene	5.0E-01	4.1E-03	6.8E-01	2.8E-03	
2,6-Dinitrotoluene	8.8E-02	7.3E-04	6.8E-01	5.0E-04	
			Total RME ILCR:	3.3E-03	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.
[b]See Appendix M for sources and methodology of toxicity values.
[c]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-31. Summary of Potential Systemic Effects for the Current/Future On-Site Laborer for SWMU 6 (Northeast Revetment Area)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.6E+01	3.8E-08	3.0E-04	1.3E-04	
Copper	1.3E+03	3.0E-06	4.0E-02	7.6E-05	
Lead	5.0E+02	NA(d)	NA	NA	
			Pathway Total:	2.0E-04	97%
Dermal Contact with Surface Soil					
Arsenic	1.6E+01	1.9E-09	2.9E-04	6.4E-06	
Copper	1.3E+03	NA	NA	NA	
Lead	5.0E+02	NA	NA	NA	
			Pathway Total:	6.4E-06	3%
Inhalation of Particulates					
Arsenic	7.6E-07	NA	NA	NA	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	2.1E-04	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.6E+01	3.6E-06	3.0E-04	1.2E-02	
Copper	1.3E+03	2.9E-04	4.0E-02	7.2E-03	
Lead	5.0E+02	NA	NA	NA	
			Pathway Total:	1.9E-02	93%
Dermal Contact with Surface Soil					
Arsenic	1.6E+01	4.2E-07	2.9E-04	1.4E-03	
Copper	1.3E+03	NA	NA	NA	
Lead	5.0E+02	NA	NA	NA	
			Pathway Total:	1.4E-03	7%
Inhalation of Particulates					
Arsenic	7.6E-07	NA	NA	NA	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	2.1E-02	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-32. Summary of Potential Systemic Effects for the Future On-Site Adult Resident for SWMU 6 (Northeast Revetment Area)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.6E+01	1.3E-06	3.0E-04	4.3E-03	
Copper	1.3E+03	1.0E-04	3.7E-02	2.8E-03	
Lead	5.0E+02	NA[d]	NA	NA	
			Pathway Total:	7.2E-03	1%
Dermal Contact with Surface Soil					
Arsenic	1.6E+01	6.5E-08	2.9E-04	2.2E-04	
Copper	1.3E+03	NA	NA	NA	
Lead	5.0E+02	NA	NA	NA	
			Pathway Total:	2.2E-04	0%
Inhalation of Particulates					
Arsenic	7.6E-07	NA	NA	NA	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Arsenic	4.4E-02	6.2E-06	3.0E-04	2.1E-02	
Copper	3.6E+01	5.0E-03	3.7E-02	1.3E-01	
Lead	1.6E+00	NA	NA	NA	
			Pathway Total:	1.6E-01	14%
Ingestion of Tubers and Fruits					
Arsenic	2.1E-02	9.8E-06	3.0E-04	3.3E-02	
Copper	7.0E+01	3.3E-02	3.7E-02	8.9E-01	
Lead	1.0E+00	NA	NA	NA	
			Pathway Total:	9.2E-01	85%
			Total CTE HI:	1.1E+00	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.6E+01	8.2E-06	3.0E-04	2.7E-02	
Copper	1.3E+03	6.6E-04	3.7E-02	1.8E-02	
Lead	5.0E+02	NA	NA	NA	
			Pathway Total:	4.5E-02	1%
Dermal Contact with Surface Soil					
Arsenic	1.6E+01	9.5E-07	2.9E-04	3.2E-03	
Copper	1.3E+03	NA	NA	NA	
Lead	5.0E+02	NA	NA	NA	
			Pathway Total:	3.2E-03	0%
Inhalation of Particulates					
Arsenic	7.6E-07	NA	NA	NA	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Arsenic	4.4E-02	2.2E-05	3.0E-04	7.2E-02	
Copper	3.6E+01	1.7E-02	3.7E-02	4.7E-01	
Lead	1.6E+00	NA	NA	NA	
			Pathway Total:	5.4E-01	14%
Ingestion of Tubers and Fruits					
Arsenic	2.1E-02	3.4E-05	3.0E-04	1.1E-01	
Copper	7.0E+01	1.2E-01	3.7E-02	3.1E+00	
Lead	1.0E+00	NA	NA	NA	
			Pathway Total:	3.2E+00	85%
			Total RME HI:	3.8E+00	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-33. Summary of Potential Systemic Effects for the Future On-Site Child Resident for SWMU 6 (Northeast Revetment Area)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.6E+01	5.9E-06	3.0E-04	2.0E-02	
Copper	1.3E+03	4.7E-04	3.7E-02	1.3E-02	
Lead	5.0E+02	NA[d]	NA	NA	
			Pathway Total:	3.2E-02	2%
Dermal Contact with Surface Soil					
Arsenic	1.6E+01	1.1E-07	2.9E-04	3.7E-04	
Copper	1.3E+03	NA	NA	NA	
Lead	5.0E+02	NA	NA	NA	
			Pathway Total:	3.7E-04	0%
Inhalation of Particulates					
Arsenic	7.6E-07	NA	NA	NA	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Arsenic	4.4E-02	1.0E-05	3.0E-04	3.3E-02	
Copper	3.6E+01	8.1E-03	3.7E-02	2.2E-01	
Lead	1.6E+00	NA	NA	NA	
			Pathway Total:	2.5E-01	14%
Ingestion of Tubers and Fruits					
Arsenic	2.1E-02	1.6E-05	3.0E-04	5.3E-02	
Copper	7.0E+01	5.3E-02	3.7E-02	1.4E+00	
Lead	1.0E+00	NA	NA	NA	
			Pathway Total:	1.5E+00	84%
			Total CTE HI:	1.8E+00	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.6E+01	2.9E-05	3.0E-04	9.7E-02	
Copper	1.3E+03	2.3E-03	3.7E-02	6.4E-02	
Lead	5.0E+02	NA	NA	NA	
			Pathway Total:	1.6E-01	4%
Dermal Contact with Surface Soil					
Arsenic	1.6E+01	6.7E-07	2.9E-04	2.3E-03	
Copper	1.3E+03	NA	NA	NA	
Lead	5.0E+02	NA	NA	NA	
			Pathway Total:	2.3E-03	0%
Inhalation of Particulates					
Arsenic	7.6E-07	NA	NA	NA	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Arsenic	4.4E-02	2.4E-05	3.0E-04	7.9E-02	
Copper	3.6E+01	1.9E-02	3.7E-02	5.2E-01	
Lead	1.6E+00	NA	NA	NA	
			Pathway Total:	5.9E-01	14%
Ingestion of Tubers and Fruits					
Arsenic	2.1E-02	3.8E-05	3.0E-04	1.3E-01	
Copper	7.0E+01	1.3E-01	3.7E-02	3.4E+00	
Lead	1.0E+00	NA	NA	NA	
			Pathway Total:	3.5E+00	82%
			Total RME HI:	4.3E+00	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-34. Summary of Potential Systemic Effects for the Future Construction Worker for SWMU 6 (Northeast Revetment Area)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Subchronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Subsurface Soil					
Aluminum	1.4E+04	7.6E-03	1.0E+00	7.6E-03	
Antimony	2.2E+01	1.2E-05	4.0E-04	3.1E-02	
Arsenic	2.2E+01	1.2E-05	3.0E-04	4.1E-02	
Chromium	4.6E+01	2.5E-05	2.0E-02	1.3E-03	
Copper	5.9E+02	3.2E-04	4.0E-02	8.1E-03	
Iron	5.4E+04	NA[d]	NA	NA	
Lead	2.6E+02	NA	NA	NA	
Thallium	4.6E+01	2.5E-05	8.0E-04	3.2E-02	
Zinc	5.2E+03	2.8E-03	3.0E-01	9.4E-03	
			Pathway Total:	1.3E-01	31%
Dermal Contact with Subsurface Soil					
Aluminum	1.4E+04	2.7E-05	2.0E-01	1.4E-04	
Antimony	2.2E+01	4.4E-08	8.0E-05	5.5E-04	
Arsenic	2.2E+01	4.3E-08	2.9E-04	1.5E-04	
Chromium	4.6E+01	9.0E-08	1.0E-03	9.0E-05	
Copper	5.9E+02	NA	NA	NA	
Iron	5.4E+04	NA	NA	NA	
Lead	2.6E+02	NA	NA	NA	
Thallium	4.6E+01	9.0E-08	1.6E-05	5.7E-03	
Zinc	5.2E+03	1.0E-05	1.5E-01	6.7E-05	
			Pathway Total:	6.6E-03	15%
Inhalation of Particulates					
Aluminum	5.4E-02	3.9E-04	1.4E-03	2.8E-01	
Antimony	8.7E-05	NA	NA	NA	
Arsenic	8.6E-05	NA	NA	NA	
Chromium	1.8E-04	NA	NA	NA	
Copper	2.3E-03	NA	NA	NA	
Iron	2.1E-01	NA	NA	NA	
Lead	1.0E+00	NA	NA	NA	
Thallium	1.8E-04	NA	NA	NA	
Zinc	2.0E-02	NA	NA	NA	
			Pathway Total:	2.8E-01	54%
			Total CTE HI:	4.2E-01	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Subsurface Soil					
Aluminum	1.4E+04	3.6E-02	1.0E+00	3.6E-02	
Antimony	2.2E+01	5.7E-05	4.0E-04	1.4E-01	
Arsenic	2.2E+01	5.7E-05	3.0E-04	1.9E-01	
Chromium	4.6E+01	1.2E-04	2.0E-02	5.9E-03	
Copper	5.9E+02	1.5E-03	4.0E-02	3.8E-02	
Iron	5.4E+04	NA	NA	NA	
Lead	2.6E+02	NA	NA	NA	
Thallium	4.6E+01	1.2E-04	8.0E-04	1.5E-01	
Zinc	5.2E+03	1.3E-02	3.0E-01	4.4E-02	
			Pathway Total:	6.1E-01	32%
Dermal Contact with Subsurface Soil					
Aluminum	1.4E+04	6.3E-04	2.0E-01	3.1E-03	
Antimony	2.2E+01	1.0E-06	8.0E-05	1.3E-02	
Arsenic	2.2E+01	1.0E-06	2.9E-04	3.5E-03	
Chromium	4.6E+01	2.1E-06	1.0E-03	2.1E-03	
Copper	5.9E+02	NA	NA	NA	
Iron	5.4E+04	NA	NA	NA	
Lead	2.6E+02	NA	NA	NA	
Thallium	4.6E+01	2.1E-06	1.6E-04	1.3E-02	
Zinc	5.2E+03	2.3E-04	1.5E-01	1.6E-03	
			Pathway Total:	3.6E-02	2%
Inhalation of Particulates					
Aluminum	5.4E-02	1.7E-03	1.4E-03	1.2E+00	
Antimony	8.7E-05	NA	NA	NA	
Arsenic	8.6E-05	NA	NA	NA	
Chromium	1.8E-04	NA	NA	NA	
Copper	2.3E-03	NA	NA	NA	
Iron	2.1E-01	NA	NA	NA	
Lead	1.0E+00	NA	NA	NA	
Thallium	1.8E-04	NA	NA	NA	
Zinc	2.0E-02	NA	NA	NA	
			Pathway Total:	1.2E+00	66%
			Total RME HI:	1.9E+00	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-35. Summary of Potential Systemic Effects for the Future Construction Worker for SWMU 6 (Hot Spot at Test Pit 3)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Subsurface Soil					
1,3,5-Trinitrobenzene	1.7E+01	9.3E-06	5.0E-04	1.9E-02	
			Pathway Total:	1.9E-02	93%
Dermal Contact with Subsurface Soil					
1,3,5-Trinitrobenzene	1.7E+01	3.3E-07	2.5E-04	1.3E-03	
			Pathway Total:	1.3E-03	7%
Inhalation of Particulates					
1,3,5-Trinitrobenzene	6.6E-05	NA(d)	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	2.0E-02	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Subsurface Soil					
1,3,5-Trinitrobenzene	1.7E+01	4.4E-05	5.0E-04	8.7E-02	
			Pathway Total:	8.7E-02	74%
Dermal Contact with Subsurface Soil					
1,3,5-Trinitrobenzene	1.7E+01	7.7E-06	2.5E-04	3.1E-02	
			Pathway Total:	3.1E-02	26%
Inhalation of Particulates					
1,3,5-Trinitrobenzene	6.6E-05	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	1.2E-01	100%

[a] Units for the inhalation pathway are mg/m^3.

[b] See Appendix L for sources and methodology on estimating a daily intake value.

[c] See Appendix M for sources and methodology of toxicity values.

[d] NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-36. Summary of Potential Systemic Effects for the Current/Future On-Site Laborer for SWMU 6 (Remainder of Site)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.2E+01	2.8E-08	3.0E-04	9.4E-05	
			Pathway Total:	9.4E-05	95%
Dermal Contact with Surface Soil					
Arsenic	1.2E+01	1.4E-09	2.9E-04	4.8E-06	
			Pathway Total:	4.8E-06	5%
Inhalation of Particulates					
Arsenic	7.6E-07	NA(d)	NA	NA	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	9.9E-05	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.2E+01	2.7E-06	3.0E-04	9.0E-03	
			Pathway Total:	9.0E-03	89%
Dermal Contact with Surface Soil					
Arsenic	1.2E+01	3.2E-07	2.9E-04	1.1E-03	
			Pathway Total:	1.1E-03	11%
Inhalation of Particulates					
Arsenic	7.6E-07	NA	NA	NA	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	1.0E-02	100%

[a] Units for the inhalation pathway are mg/m^3.
[b] See Appendix L for sources and methodology on estimating a daily intake value.
[c] See Appendix M for sources and methodology of toxicity values.
[d] NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-37. Summary of Potential Systemic Effects for the Future On-Site Adult Resident for SWMU 6 (Remainder of Site)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.2E+01	9.8E-07	3.0E-04	3.3E-03	
			Pathway Total:	3.3E-03	7%
Dermal Contact with Surface Soil					
Arsenic	1.2E+01	4.9E-08	2.9E-04	1.7E-04	
			Pathway Total:	1.7E-04	0%
Inhalation of Particulates					
Arsenic	7.6E-07	NA[d]	NA	NA	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Arsenic	3.3E-02	4.7E-06	3.0E-04	1.6E-02	
			Pathway Total:	1.6E-02	36%
Ingestion of Tubers and Fruits					
Arsenic	1.6E-02	7.4E-06	3.0E-04	2.5E-02	
			Pathway Total:	2.5E-02	56%
			Total CTE HI:	4.4E-02	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.2E+01	6.2E-06	3.0E-04	2.1E-02	
			Pathway Total:	2.1E-02	13%
Dermal Contact with Surface Soil					
Arsenic	1.2E+01	7.2E-07	2.9E-04	2.4E-03	
			Pathway Total:	2.4E-03	1%
Inhalation of Particulates					
Arsenic	7.6E-07	NA	NA	NA	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Arsenic	3.3E-02	1.6E-05	3.0E-04	5.4E-02	
			Pathway Total:	5.4E-02	33%
Ingestion of Tubers and Fruits					
Arsenic	1.6E-02	2.6E-05	3.0E-04	8.6E-02	
			Pathway Total:	8.6E-02	53%
			Total RME HI:	1.6E-01	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-38. Summary of Potential Systemic Effects for the Future On-Site Child Resident for SWMU 6 (Remainder of Site)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.2E+01	4.4E-06	3.0E-04	1.5E-02	
			Pathway Total:	1.5E-02	18%
Dermal Contact with Surface Soil					
Arsenic	1.2E+01	8.2E-08	2.9E-04	2.8E-04	
			Pathway Total:	2.8E-04	0%
Inhalation of Particulates					
Arsenic	7.6E-07	NA[d]	NA	NA	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Arsenic	3.3E-02	7.6E-06	3.0E-04	2.5E-02	
			Pathway Total:	2.5E-02	31%
Ingestion of Tubers and Fruits					
Arsenic	1.6E-02	1.2E-05	3.0E-04	4.0E-02	
			Pathway Total:	4.0E-02	50%
			Total CTE HI:	8.0E-02	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.2E+01	2.2E-05	3.0E-04	7.3E-02	
			Pathway Total:	7.3E-02	32%
Dermal Contact with Surface Soil					
Arsenic	1.2E+01	5.0E-07	2.9E-04	1.7E-03	
			Pathway Total:	1.7E-03	1%
Inhalation of Particulates					
Arsenic	7.6E-07	NA	NA	NA	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Arsenic	3.3E-02	1.8E-05	3.0E-04	5.9E-02	
			Pathway Total:	5.9E-02	26%
Ingestion of Tubers and Fruits					
Arsenic	1.6E-02	2.8E-05	3.0E-04	9.4E-02	
			Pathway Total:	9.4E-02	41%
			Total RME HI:	2.3E-01	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-39. Summary of Potential Systemic Effects for the Current/Future On-Site Laborer for SWMU 6 as a Whole

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.5E+01	3.6E-08	3.0E-04	1.2E-04	
Copper	7.8E+01	1.9E-07	3.7E-02	5.0E-06	
Lead	9.0E+01	NA[d]	NA	NA	
			Pathway Total:	1.2E-04	100%
Dermal Contact with Surface Soil					
Arsenic	1.5E+01	1.8E-09	2.9E-04	5.2E-13	
Copper	7.8E+01	NA	NA	NA	
Lead	9.0E+01	NA	NA	NA	
			Pathway Total:	5.2E-13	0%
Inhalation of Particulates					
Arsenic	7.6E-07	NA	NA	NA	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	1.2E-04	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.5E+01	3.4E-06	3.0E-04	1.1E-02	
Copper	7.8E+01	1.8E-05	3.7E-02	4.8E-04	
Lead	9.0E+01	NA	NA	NA	
			Pathway Total:	1.2E-02	100%
Dermal Contact with Surface Soil					
Arsenic	1.5E+01	4.0E-07	2.9E-04	1.2E-10	
Copper	7.8E+01	NA	NA	NA	
Lead	9.0E+01	NA	NA	NA	
			Pathway Total:	1.2E-10	0%
Inhalation of Particulates					
Arsenic	7.6E-07	NA	NA	NA	
Copper	3.9E-06	NA	NA	NA	
Lead	4.6E-06	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	1.2E-02	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-40. Summary of Systemic Effects for the Ingestion of Groundwater Pathway by the Future On-Site Adult Resident for SWMU 6

Chemical	Exposure Point Concentration (mg/L)	Daily Noncarcinogenic Intake[(a)] (mg/kg-day)	Chronic RfD[(b)] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
<u>Ingestion of Groundwater</u>					
RDX	3.3E-02	3.8E-04	3.0E-03	1.3E-01	
1,3,5-Trinitrobenzene	1.7E-01	2.0E-03	5.0E-05	4.0E+01	
2,4-Dinitrotoluene	5.0E-01	5.7E-03	2.0E-03	2.9E+00	
2,6-Dinitrotoluene	8.8E-02	1.0E-03	1.0E-03	1.0E+00	
			Total CTE HI:	4.4E+01	100%
Reasonable Maximum Exposure (RME) Scenario					
<u>Ingestion of Groundwater</u>					
RDX	3.3E-02	6.9E-04	3.0E-03	2.3E-01	
1,3,5-Trinitrobenzene	1.7E-01	3.6E-03	5.0E-05	7.2E+01	
2,4-Dinitrotoluene	5.0E-01	1.0E-02	2.0E-03	5.2E+00	
2,6-Dinitrotoluene	8.8E-02	1.8E-03	1.0E-03	1.8E+00	
			Total RME HI:	7.9E+01	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.
[b]See Appendix M for sources and methodology of toxicity values.

Current/Future On-Site Laborer. The cumulative ILCR for all pathways is 2.1E-06 and 2.9E-09 for the RME and CTE scenarios, respectively. As summarized in Table 5-20, the driving pathway is ingestion of surface soil which contributes greater than 78 percent of the estimated risk.

Total ILCR for ingestion of surface soil by laborers is 1.8E-06 and 2.3E-09 for the RME and CTE scenarios, respectively. Dermal contact with surface soil and inhalation of particulates by laborers does not present an individual risk above the lower bound of the target risk range. The estimated ILCRs for these pathways range from 2.1E-07 to 1.2E-10. Arsenic is the only contributor to the estimated risks.

Future On-Site Adult Resident. The cumulative ILCR for all pathways is 3.9E-05 and 2.8E-06 for the RME and CTE scenarios, respectively. As summarized in Table 5-21, the driving pathway is ingestion of produce, which contributes greater than 85 percent of the estimated risk.

Incremental lifetime cancer risk, attributed to ingestion of homegrown produce by adults, results in an estimated ILCR of 3.4E-05 and 2.6E-06 using RME and CTE parameters, respectively. Ingestion of surface soil by adults during yard work, gardening, etc., results in an estimated ILCR of 4.9E-06 using RME conditions and 2.1E-07 using the CTE conditions. The ILCRs for the remaining pathways evaluated—dermal contact with surface soil and inhalation of particulates—are below the target risk range for both the RME and CTE scenarios, and range from 5.9E-07 to 1.1E-08. Arsenic is the sole contributor to this risk estimate.

Future On-site Child Resident. The cumulative ILCR for all pathways is 3.3E-05 and 5.3E-06 for the RME and CTE scenarios, respectively. As summarized in Table 5-22, the driving pathway is ingestion of produce, which contributes greater than 67 percent of the estimated risk.

Incremental lifetime cancer risk, attributed to ingestion of homegrown produce by children, results in an estimated ILCR of 2.3E-05 and 4.2E-06 using RME and CTE parameters, respectively. Ingestion of surface soil by children during yard work, playing, etc., results in an estimated ILCR of 1.0E-05 using RME conditions and 9.4E-07 using the CTE conditions. The ILCRs for the remaining pathways evaluated—dermal contact with surface soil and inhalation of particulates—are below the target risk range for both the RME and CTE scenarios, and range from 3.4E-07 to 1.8E-08. Arsenic is the sole contributor to this risk estimate.

Future Construction Worker. The cumulative ILCR for all pathways is 1.5E-05 and 1.1E-06 for the RME and CTE scenarios, respectively. As summarized in Table 5-23, the driving pathway is inhalation of particulates generated from subsurface soil, which contributes greater than 76 percent of the estimated risk.

Total ILCR for inhalation of particulates generated from subsurface soil is 1.1E-05 and 8.6E-07 for the RME and CTE scenarios, respectively. For the ingestion of subsurface soil

pathway, the total ILCR for the RME and CTE scenarios is 3.4E-06 and 2.4E-07, respectively. Dermal contact with subsurface soil does not present an ILCR above the lower bound of the target risk range. The only contributors to the estimated risk are arsenic and chromium.

Hot Spot at Test Pit 3 Area of Concern. The general process used to select the COPCs associted with the Test Pit area of concern is described in Section 3.1.1. COPC selection for SWMU 6 is described in Section 5.1.4.2. For future land use scenarios, no COPCs were identified as carcinogens. Table 5-16 lists the COPC and their associated media.

Future Construction Worker. The cumulative ILCR for all pathways is not evaluated because 1,3,5-trinitrobenzene is not classified as a carcinogen.

Remainder of SWMU 6 (Outside Areas of Concern). The general process used to select the COPCs associated with the remainder of SWMU 6 is described in Section 3.1.1. COPC selection for SWMU 6 is described in Section 5.1.4.2. For future land use scenarios, arsenic, copper, and lead were identified as COPCs. Arsenic, a known human carcinogen, is the only COPC that contributes to the carcinogenic risk. Tables 5-17 and 5-18 list the COPCs and their associated media.

Current/Future On-site Laborer. The cumulative ILCR for all pathways is 1.6E-06 and 2.3E-09 for the RME and CTE scenarios, respectively. As summarized in Table 5-24, the driving pathway is ingestion of surface soil, which contributes greater than 74 percent of the estimated risk.

Total ILCR for incidental ingestion of surface soil by laborers is 1.4E-06 and 1.7E-09 for the RME and CTE scenarios, respectively. Dermal contact with surface soil and inhalation of particulates by laborers does not present an individual risk above the lower bound of the target risk range. The estimated ILCRs for these pathways range from 1.6E-07 to 8.7E-11. Arsenic is the only contributor to the estimated risks.

Future On-site Adult Resident. The cumulative ILCR for all pathways is 3.0E-05 and 2.1E-06 for the RME and CTE scenarios, respectively. As summarized in Table 5-25, the driving pathway is ingestion of produce, which contributes greater than 85 percent of the estimated risk.

Incremental lifetime cancer risk, attributed to ingestion of homegrown produce by adults, results in an estimated ILCR of 2.5E-05 and 1.9E-06 using RME and CTE parameters, respectively. Ingestion of surface soil by adults during yard work, gardening, etc., results in an estimated ILCR of 3.7E-06 using RME conditions and 1.6E-07 using the CTE conditions. The ILCRs for the remaining pathways evaluated—dermal contact with surface soil and inhalation of particulates—are below the target risk range for both the RME and CTE scenarios, and range from 4.4E-07 to 8.0E-09. Arsenic is the sole contributor to this risk estimate.

Future On-site Child Resident. The cumulative ILCR for all pathways is 2.5E-05 and 4.1E-06 for the RME and CTE scenarios, respectively. As summarized in Table 5-26, the driving pathway is ingestion of produce, which contributes greater than 67 percent of the estimated risk.

Incremental lifetime cancer risk, attributed to ingestion of homegrown produce by children, results in an estimated ILCR of 1.6E-05 and 3.1E-06 using RME and CTE parameters, respectively. Ingestion of surface soil by children during yard work, playing, etc., results in an estimated ILCR of 7.9E-06 using RME conditions and 7.1E-07 using the CTE conditions. The ILCRs for the remaining pathways evaluated—dermal contact with surface soil and inhalation of particulates—are below the target risk range for both the RME and CTE scenarios, and range from 3.4E-07 to 1.3E-08. Arsenic is the sole contributor to this risk estimate.

SWMU 6 As a Whole. The general process used to select the COPCs associated with SWMU 6 as a whole is described in Section 3.1.1. COPC selection for SWMU 6 is described in Section 5.1.4.2. For current land use scenarios, arsenic, copper, and lead were identified as COPCs. Arsenic, a known human carcinogen, is the only COPC that contributes to the carcinogenic risk.

RDX, 2,4- and 2,6-dinitrotoluene, and 1,3,5-trinitrobenzene were identified as COPCs for the hypothetical future ingestion of groundwater pathway for on-site adult residents. RDX, a possible human carcinogen, and 2,4- and 2,6-dinitrotoluene, suspected human carcinogens, are the only COPCs that contribute to the carcinogenic risk. The compound 1,3,5-trinitrobenzene is not classified as a carcinogen. Table 5-19 lists the COPCs and their associated media.

Current/Future On-site Laborer. The cumulative ILCR for all pathways is 2.0E-06 and 2.8E-09 for the RME and CTE scenarios, respectively. As summarized in Table 5-27, the driving pathway is ingestion of surface soil, which contributes greater than 77 percent of the estimated risk.

Total ILCR for incidental ingestion of surface soil by laborers is 1.7E-06 and 2.1E-09 for the RME and CTE scenarios, respectively. Dermal contact with surface soil and inhalation of particulates by laborers does not present an individual risk above the lower bound of the target risk range. The estimated ILCRs for these pathways range from 2.0E-07 to 1.1E-10. Arsenic is the only contributor to the estimated risks.

Current Off-site Adult Resident. The cumulative ILCR for the inhalation pathway does not exceed the lower bound limit of the target risk range. The total ILCR is 1.9E-07 and 3.5E-08 for the RME and CTE scenarios, respectively, as summarized in Table 5-28. The sole contributor to these risk estimates is arsenic.

Current Off-site Child Resident. The cumulative ILCR for the inhalation pathway does not exceed the lower bound limit of the target risk range. The total ILCR is 2.9E-07 and 1.8E-07 for the RME and CTE scenarios, respectively, as summarized in Table 5-29. The sole contributor to these risk estimates is arsenic.

Future On-site Adult Resident. Evaluated separately from the soil and air pathways, ingestion of groundwater by potential on-site adult residents results in a cumulative ILCR of 3.3E-03 to 4.9E-04 for the RME and CTE scenario (See Table 5-30). However, it should be noted that environmental degradation of the COPCs evaluated was not taken into account when estimating the EPC. It is also estimated that these potential COPCs will not reach the water table for at least 2 to 3 decades from this point in time. For these reasons, the RME and CTE ILCRs for the ingestion of groundwater pathway are very likely to be an overestimate of risk.

5.1.4.6.2 *Characterization of Potential Systemic Effects*

Northeast Revetment Area of Concern. The general process used to select the COPCs associated with the Northeast Revetment Area of concern is described in Section 3.1.1. COPC selection for SWMU 6 is described in Section 5.1.4.2. For current and future land use scenarios, aluminum, antimony, arsenic, chromium, copper, iron, lead, thallium, and zinc were identified as COPCs. All COPCs were evaluated for potential systemic effects with the exception of iron and lead. Tables 5-14 and 5-15 list the COPC and their associated media.

Current/Future On-site Laborers. As summarized in Table 5-31, the summed HI for all pathways does not exceed unity and ranges from 2.1E-02 to 2.1E-04 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of surface soil, which contributes greater than 93 percent of the total HI. The sole contributors to these risk estimates are arsenic and copper.

Future On-site Adult Resident. As summarized in Table 5-32, the summed HI for all pathways ranges from 3.8E+00 to 1.1E+00 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of produce, which contributes greater than 99 percent of the total HI. Arsenic and copper are the only contributors to the ingestion of produce HI. Inhalation reference doses for arsenic, copper, and lead were not available at the time of this report.

The total HI for ingestion of produce by adult residents is 3.7E+00 and 1.1E+00 for the RME and CTE scenarios, respectively. The HIs for the remaining pathways evaluated are below unity and range from 4.5E-02 to 2.2E-04.

Future On-site Child Resident. As summarized in Table 5-33, the summed HI for all pathways ranges from 4.3E+00 to 1.8E+00 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of produce, which contributes greater than 96 percent of the total HI. Arsenic and copper are the only contributors to the ingestion of produce HI. Inhalation reference doses for arsenic, copper, and lead were not available at the time of this report.

The total HI for ingestion of produce by child residents is 4.1E+00 and 1.8E+00 for the RME and CTE scenarios, respectively. The HIs for the remaining pathways evaluated are below unity and range from 1.6E-01 to 3.7E-04.

Future Construction Worker. As summarized in Table 5-34, the summed HI for all pathways ranges from 1.9E+00 to 4.2E-01 for the RME and CTE scenarios, respectively. The driving pathway for the RME scenario is inhalation of particulates, which contributes greater than 66 percent of the total HI. The only contributor to the inhalation pathway HI is aluminum. Inhalation reference doses for the remaining COPCs were not available at the time of this report.

The total HI for inhalation of particulates is 1.2E+00 and 2.8E-01 for the RME and CTE scenarios, respectively. As stated above, aluminum is the only contributor to the HI estimates for the inhalation of particulates for both the RME and CTE scenarios. The HIs for the remaining pathways evaluated are below unity and range from 6.1E-01 to 6.6E-03.

Hot Spot at Test Pit 3 Area of Concern. The general process used to select the COPCs associated with the Test Pit area of concern is described in Section 3.1.1. COPC selection for SWMU 6 is described in Section 5.1.4.2. For future land use scenarios, 1,3,5-trinitrotoluene was identified as the sole COPC. An inhalation reference dose for this COPC is not currently available; therefore, systemic effects for the inhalation of particulates generated from subsurface soil pathway were not evaluated. Table 5-16 lists the COPC and their associated media.

Future Construction Worker. As summarized in Table 5-35, the summed HI for all pathways does not exceed unity and ranges from 1.2E-01 to 2.0E-02 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of subsurface soil, which contributes greater than 74 percent of the total HI.

Remainder of SWMU 6 (Not Including Areas of Concern). The general process used to select the COPCs associated with the remainder of SWMU 6, which does not include areas of concern, is described in Section 3.1.1. COPC selection for SWMU 6 is described in Section 5.1.4.2. For current land use scenarios, arsenic, copper and lead were identified as COPCs. Inhalation reference doses for these COPCs are not currently available; therefore, systemic effects for the inhalation of particulates generated from surface soil pathway were not evaluated. Tables 5-17 and 5-18 list the COPC and their associated media.

Current/Future On-site Laborer. As summarized in Table 5-36, the summed HI for all pathways does not exceed unity and ranges from 1.0E-02 to 9.9E-05 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of surface soil, which contributes greater than 89 percent of the total HI.

Future On-site Adult Resident. As summarized in Table 5-37, the summed HI for all pathways does not exceed unity and ranges from 1.6E-01 to 4.4E-02 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of produce, which contributes greater than 86 percent of the total HI.

Future On-site Child Resident. As summarized in Table 5-38, the summed HI for all pathways does not exceed unity and ranges from 2.3E-01 to 8.0E-02 for the RME and CTE

scenarios, respectively. The driving pathway is ingestion of produce, which contributes greater than 67 percent of the total HI.

SWMU 6 As a Whole. The general process used to select the COPCs associated with SWMU 6 as a whole is described in Section 3.1.1. COPC selection for SWMU 6 is described in Section 5.1.4.2. For current land use scenarios, arsenic, copper, and lead were identified as COPCs. Inhalation reference doses for these COPCs are not currently available; therefore, systemic effects for the inhalation of particulates generated from surface soil pathway were not evaluated.

RDX, 2,4- and 2,6-dinitrotoluene, and 1,3,5-trinitrobenzene were identified as COPCs for the hypothetical future ingestion of groundwater pathway for on-site adult residents. All COPCs were evaluated for potential systemic effects. Table 5-19 lists the COPC and their associated media.

Current/Future On-site Laborer. As summarized in Table 5-39, the summed HI for all pathways does not exceed unity and ranges from 1.2E-02 to 1.2E-04 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of surface soil, which contributes nearly 100 percent of the total HI.

Current Off-site Adult Resident. Inhalation reference doses for the COPCs associated with SWMU 6 as a whole are not currently available; therefore, systemic effects for the inhalation of particulates generated from surface soil pathway were not evaluated.

Current Off-site Child Resident. Inhalation reference doses for the COPCs associated with SWMU 6 as a whole are not currently available; therefore, systemic effects for the inhalation of particulates generated from surface soil pathway were not evaluated.

Future On-site Adult Resident. Evaluated separately from the soil and air pathways, ingestion of groundwater by potential on-site adult residents results in a summed HI of 7.9E+01 and 4.4E+01 for the RME and CTE scenario (see Table 5-40). However, it should be noted that environmental degradation of the COPCs evaluated was not taken into account when estimating the EPC. It is also estimated that these potential COPCs will not reach the water table for at least 2 to 3 decades from this point in time. Additionally, the HI estimation assumes additivity of effects for all COPCs evaluated. As described in Appendix M, the critical effects for the COPCs evaluated are as follows: RDX—inflammation of the prostate; 1,3,5-trinitrobenzene—increased splenic weight; and dinitrotoluenes—neurotoxicity, Heinz bodies, and biliary tract hyperplasia. For these reasons, the RME and CTE HIs for the ingestion of groundwater pathway are very likely to be an overestimate of risk.

5.1.4.6.3 *Characterization of Hazards Associated with Exposures to Lead*

Current Off-site Child Residents. The USEPA has developed the IEUBK model to evaluate lead exposure in children. The model estimates blood lead levels resulting from all applicable

routes of exposure. The agency has set a target blood lead level of 10 μg Pb/dL blood. The IEUBK model was run for potential off-site residential exposures to resuspended lead-containing particulate. All defaults in the model were maintained except the input air concentration. This input value was the boundary line concentration resulting from the air dispersion modeling (Appendix N). Predicted mean blood lead levels ranged from 4.5 μg Pb/dL blood for children aged 1 to 2 years down to 2.7 μg Pb/dL blood for children aged 6 to 7 years. Mean blood lead level for the age span 0 to 7 years was 3.7 μg Pb/dL blood, which is below the USEPA target blood lead level of 10 μg Pb/dL blood.

Future On-site Child Residents. The IEUBK model was run for potential future on-site residential exposures to lead in soil, produce, air, and drinking water. All defaults in the model were maintained except the input air, soil, and produce concentrations and the parameters–time spent outdoors, 3 hours/day, and lung absorption rate, 50 percent (see Appendix L). The input air value is the boundary line concentration resulting from the air dispersion modeling (Appendix N). Lead concentrations in soil and produce are based on an average EPC for lead. Predicted mean blood lead levels ranged from 6.4 μg Pb/dL blood for children aged 1 to 2 years down to 3.7 μg Pb/dL blood for children aged 6 to 7 years. Mean blood lead level for the age span 0 to 7 years is 5.20 μg Pb/dL blood, which is below the USEPA target blood lead level of 10 μg Pb/dL blood. Soil and dust uptake is the driving pathway, contributing greater than 70 percent of the total blood lead level.

Occupational Scenario. The agency recognizes that this approach is not appropriate for land use best described by non-residential adult exposure (USEPA 1994d). The agency has recommended a short-term option based on a simple approach that approximates the more complicated biokinetics in humans. Models for adult exposure are available in the scientific literature and meet USEPA's short-term criterion. Exposures and acceptable residual soil levels were estimated using the model developed by Bowers and colleagues (1994) as modified by USEPA Region VIII in the risk assessment for the California Gulch Superfund Site (USEPA 1995b) (see Appendix O). A target blood lead level range of 11.1 μg Pb/dL blood was used in the evaluation to account for women of child-bearing age in the work force (USEPA 1995b).

For the the on-site laborer, two exposure settings were used to estimate the blood lead levels for the CTE and RME exposure Northeast Revetment Area of Concern and SWMU 6 as a whole. In addition, the potential future construction worker scenario was evaluated for the the Northeast Revetment Area of Concern. For the both receptors, the blood lead levels for the RME (2.27 to 2.42 for the laborer and 3.86 for the construction worker) and CTE (2.20 for the laborer and 2.54 for the construction worker) scenarios are below the USEPA's target blood lead level range of 11.1 μg Pb/dL blood.

At the request of EPA Region VIII, a subsurface lead "hot spot" within the Northeast Revetment Area was investigated separately. The "hot spot" involved three data points with concentrations ranging from 3,600 mg/kg to 17,000 mg/kg. Although the Bowers model used for the construction waorker scenario requires a measure of central tendency as an input (e.g., arithmetic mean, geometric mean), the number of data points is too small to derive a

meaningful estimate of a mean. Therefore, the maximum (17,000 mg/kg) and minimum (3,600 mg/kg) values were separately used as inputs to the Bowers model for both the RME and CTE construction worker scenarios.

As one might expect when using a single value as a constant EPC, the resulting blood lead levels exceeded the reference value. RME construction worker levels range from 20 μg Pb/dl blood to 110 μg Pb/dl blood. CTE construction worker scenarios ranged from 7 μg Pb/dl blood (below the 11.1 μg Pb/dl blood target level) to 24 μg Pb/dl blood.

5.1.4.7 *Risk Assessment Summary and Conclusions*

A baseline risk assessment was conducted for the Old Burn Area (SWMU 6) based on Phase I and Phase II RI data. Four current- and future-use scenarios were quantitatively evaluated:

- On-site laborer/security worker
- Off-site resident (inhalation only)
- On-site residents (redevelopment)
- Construction worker (during redevelopment)

A summary of RME risk results for SWMU 6 is shown in Table 5-41 and of CTE risk results in Table 5-42. For the current/future on-site laborer/security worker, all scenarios were found to fall within or below the target risk range of 1E-04 to 1E-06 for the ILCR and unity for the total HI.

The ILCRs for both adult and child RME off-site residents were below the target risk range of 1.0E-06. Inhalation reference doses for the COPCs associated with SWMU 6 as a whole are not currently available; therefore, systemic effects for the inhalation of particulates generated from surface soil pathway were not evaluated.

The ILCRs for both adult and child RME on-site residents were within the target risk range of 10^{-4} to 10^{-6}. The total resident HI for the Northeast Revetment Area of concern is above unity, 3.8 and 1.1 for the adult and 4.3 and 1.8 for the child RME and CTE scenarios, respectively. It should be remembered that any estimate of risk is dependent on the concurrent validity of all assumptions used to construct the exposure model. In other words, the estimates rely on several activities recurring with constant intensity and in predictable order. For example, produce ingestion assumes a constant consumption rate every day for durations up to 30 years for adults and 18 years for children. Food-chain pathways (i.e., home gardening) are significant contributors to total risks. According to Lee Sherry, a home economist with the Utah State University Agricultural Extension Service in Tooele, saline content in area soils generally require home gardeners and landscapers to replace or augment the existing soil with new topsoil. The above observation is confirmed by soil testing results from the Utah State University Soil Testing Laboratory (Appendix G).

Table 5-41. *Summary of RME Risk Results for SWMU 6*

Scenario	Northeast Revetment Area[a]			Hot Spot Test Pit 3		Remainder of SWMU		SWMU as a Whole		
	HI	ILCR	Blood Lead Levels (μg Pb/dL Blood)	HI	ILCR	HI	ILCR	HI	ILCR	Blood Lead Levels (μg Pb/dL Blood)
Current Land Use										
On-site Laborer	2.0E-02	2.1E-06	2.42	---(b)	---	1.0E-02	1.6E-06	1.2E-02	2.0E-06	2.24
Off-site Adult Resident	---	---	---	---	---	---	---	NA(c)	1.9E-07	---(d)
Off-site Child Resident	---	---	---	---	---	---	---	NA	2.9E-07	3.70
Future Land Use										
On-site Adult Resident	3.8E+00	4.0E-05	---(d)	---	---	1.6E-01	3.0E-05	---	---	---
On-site Child Resident	4.3E+00	3.3E-05	6.00	---	---	2.3E-01	2.5E-05	---	---	---
Construction Worker	1.9E+00	1.4E-05	3.86	1.2E-01	NA	---	---	---	---	---

[a]At the request of USEPA Region VIII, a subset of subsurface soil data was evaluated separately as a "hot spot." Lead concentrations (3 data points) ranged from 3,600 mg/kg to 17,000 mg/kg.
All blood levels for the construction worker scenario exceeded the targeted level except for the CTE scenario at 3,600 mg/kg.
[b]Not evaluated.
[c]Not applicable.
[d]Per EPA Guidance, the IEUBK model is designed for the child receptor, who is the most sensitive receptor. Therefore, blood levels for the adult receptor were not quantified.

Table 5-42. *Summary of CTE Risk Results for SWMU 6*

Scenario	Northeast Revetment Area[a]			Hot Spot Test Pit 3		Remainder of SWMU		SWMU as a Whole		
	HI	ILCR	Blood Lead Levels (μg Pb/dL Blood)	HI	ILCR	HI	ILCR	HI	ILCR	Blood Lead Levels (μg Pb/dL Blood)
Current Land Use										
On-site Laborer	2.1E-04	2.9E-09	2.20	---(b)	---	9.9E-05	2.3E-09	1.2E-04	2.8E-09	2.20
Off-site Adult Resident	---	---	---	---	---	---	---	NA(c)	3.5E-08	---(d)
Off-site Child Resident	---	---	---	---	---	---	---	NA	1.8E-07	3.70
Future Land Use										
On-site Adult Resident	1.1E+00	2.8E-06	---(d)	---	---	4.4E-02	2.1E-06	---	---	---
On-site Child Resident	1.8E+00	5.3E-06	6.00	---	---	8.0E-02	4.1E-06	---	---	6.00
Construction Worker	4.2E-01	1.1E-06	2.54	2.0E-02	NA	---	---	---	---	3.86

[a]At the request of USEPA Region VIII, a subset of subsurface soil data was evaluated separately as a "hot spot." Lead concentrations (3 data points) ranged from 3,600 mg/kg to 17,000 mg/kg.
All blood levels for the construction worker scenario exceeded the targeted level except for the CTE scenario at 3,600 mg/kg.
[b]Not evaluated.
[c]Not applicable.
[d]Per EPA Guidance, the IEUBK model is designed for the child receptor, who is the most sensitive receptor. Therefore, blood levels for the adult receptor were not quantified.

In the United Kingdom, studies of crops grown in soils near mining operations that are heavily contaminated with arsenic do not show appreciable arsenic uptake. In Poland, vegetables grown in high arsenic containing soils near power stations, superphosphate plants, and smelters all measure less than 0.2 μg/g wet weight (O'Neill 1990). This is an order of magnitude less than that predicted by the models used in this risk assessment employing the transfer coefficients developed by Baes and coworkers (1984).

The ILCRs for the future construction worker fall within the target risk range of 1.0E-04 to 1.0E-06. The total HI is below unity with the exception of the Northeast Revetment Area of concern. The HI for this area of concern is 1.9E+00 for the RME, with the driving pathway being inhalation of particulates. As stated above, it should be remembered that any estimate of risk is dependent on the concurrent validity of all assumptions used to construct the exposure model. Particulate inhalation assumes (1) a constant inhalation rate every day for durations up to 3 years and (2) all air inhaled came from SWMU 6 subsurface soil only. Due to a lack of verified toxicity data for lead, potential systemic effects for that metal were quantitatively evaluated based on USEPA's Integrated Exposure Uptake Biokinetic Model (USEPA 1994) for lead in children. The model estimates blood lead levels resulting from all applicable routes of exposure. The agency has set a target blood lead level of 10 μg Pb/dL blood. For the inhalation of particulates pathway for the current off-site child resident, a mean blood lead level of 3.7 μg Pb/dL for the age span 0 to 7 years was estimated, which is below the USEPA target blood lead level of 10 μg Pb/dL blood. Predicted mean blood lead levels for the hypothetical on-site child resident ranged from 5.2 μg Pb/dL blood for children aged 1 to 2 years down to 3.7 μg Pb/dL blood for children aged 6 to 7 years. Mean blood lead level for the age span 0 to 7 years is 5.2 μg Pb/dL blood, which is below the USEPA target blood lead level of 10 μg Pb/dL blood.

For the the on-site laborer, two exposure settings were used to estimate the blood lead levels for the CTE and RME exposure Northeast Revetment Area of concern and SWMU 6 as a whole. In addition, the potential future construction worker scenario was evaluated for the the Northeast Revetment Area of concern. For the both receptors, the blood lead levels for the RME and CTE scenarios are below the USEPA's target blood lead level range of 11.1 μg Pb/dL blood. A hot spot analysis within the revetment for the construction worker scenario yielded blood lead levels exceeding the reference value of 11.1 μg/g Pb/dL. This indicates that cleanup of this portion of the SWMU would be required prior to conducting any construction activities.

When site-specific conditions are considered along with the conservative assumptions designed to offset assessment uncertainties, the risk estimates for the future residential scenario are, in point of fact, likely to be overestimates. Under the current BRAC, SWMU 6 is not included in the parcel for potential release for private redevelopment. The mission of SWMU 6 is assumed to continue into the indefinite future. Based on the available analytical data and the above considerations, the risk assessment results indicate that there is no immediate and substantial danger to human health from the presence of low levels of hazardous chemicals at SWMU 6. Prior to any change in land use, however, removal of metals contaminated soils of the Northeast Revetment Area would be required.

5.1.5 Conclusions and Recommendations

During the summer of 1994, the Old Burn Area (SWMU 6) Phase II RI field investigation was conducted to further characterize the nature and extent of contamination detected during the Phase I RI investigation. The Phase II RI sampling effort consisted of surface and subsurface soil sampling for metals, explosives, and dioxins/furans. Phase II RI results indicated the presence of various metals exceeding their respective background values and the explosive RDX in the soils surrounding the site. Buried metal debris was encountered in a number of test pits excavated at SWMU 6. Outside of the revetment area, elevated metals were detected but only in near surface soils. Within the revetment area, elevated metals were detected in surface and subsurface soils at concentrations that generally decrease with depth. Dioxins/furans were detected in nearly all surface and subsurface samples collected at SWMU 6. Concentrations, however, were low and considered to be at background levels.

A baseline human health risk assessment was conducted at this SWMU to determine any potential human health risks associated with a no-action alternative. COPCs were evaluated in both surface and subsurface soil media based on Phase I and Phase II RI data analysis on an area of concern and an entire SWMU basis. Arsenic, copper, and lead were the only COPCs retained for further evaluation in surface soil in the northeast revetment area. For subsurface soil, aluminum, antimony, arsenic, chromium, copper, iron, lead, thallium, and zinc were retained. For the future construction worker, a hot spot for 1,3,5-trinitobenzene was evaluated. For the remainder of the SWMU, arsenic, copper, and lead were retained. For the groundwater pathway, the explosives RDX, 1,3,5-trinitrobenzene, 2,4-dinitrotoluene, and 2,6-dinitrotoluene were retained. The RME and CTE evaluated for several current and future use scenarios resulted in risk estimates falling within or below the target ranges for tolerable ICLRs and HIs as summarized in Tables 5-41 and 5-42.

These risk assessment results indicate that risks to human health from the presence of low levels of hazardous chemicals at SWMU 6 are at acceptable levels when compared with risk-based criteria except for HIs for future residents and construction workers at the Northeast Revetment Area, which exceed the goal of unity (one) due primarily to ingestion of produce and groundwater (residents) and inhalation of particulates. Due to the unacceptable hazards identified for these potential future receptors, emphasis should be placed during the Feasibility Study process on developing remedial action alternatives for the Northeast Revetment area of concern, including an evaluation of the need for removal actions to reduce hazards to acceptable levels. Ecological risk results for SWMU 6 are presented in the TEAD SWERA Report (Rust E&I 1996). Therefore, it is recommended that no further remedial investigations are necessary. An FS will be conducted for SWMU 6, as required by CERCLA, to determine if any other remedies are required for this SWMU. Conclusions from this report and the SWERA will be used during the FS process to derive final recommendations for SWMU 6.

The debris and UXO surveys conducted at SWMU 6 indicate that none of the material that was encountered in the pits was live. However, this is not 100 percent assurance that there is not live UXO at this SWMU. It is, therefore, recommended that UXO clearance be provided prior to any work or sampling at SWMU 6. Additionally, prior to granting any future land

use activities, it is recommended that the entire SWMU be surveyed for UXO to a depth that is appropriate for the given future land use application.

Due to the unacceptable hazards identified for potential future receptors, emphasis should be placed during the FS process on developing remedial action alternatives for the Northeast Revetment Area of concern, including an evaluation of the need for removal actions to reduce hazards to acceptable levels. Of particular interest is the hot spot evaluated for risks associated with lead contamination. USAEC has plans to conduct additional surface sampling for lead analysis in the Northeast Revetment Areas to further characterize the extent of this contamination.

On the basis of the contamination found in trenches at SWMU 6, further characterization of trench areas would be required prior to the start of any construction activities. This requirement should be included in evaluation of remedial action alternatives during the FS process for SWMU 6.

5.2 CHEMICAL RANGE (SWMU 7)

5.2.1 Site Characteristics

The Chemical Range, which covers 550 acres, runs east-west along the southern TEAD fence line (see Figure 1-2). At the eastern point of the firing range is the firing point, and the bullet stop is located about 4,860 feet to the west. A concrete building foundation remains at the eastern end of the firing course. Chemical and pyrotechnic-type munitions, excluding agent-filled munitions, were tested and disposed of at the Chemical Range (SWMU 7). Munition tests included flares, smoke grenades, smoke pots, projectiles, and incendiary items such as bombs, pouch and document destroyers, riot-control munitions, and flame-thrower igniters. In 1990, E.C. Jordan (1990a) investigated two open trenches and located a possible third buried trench (identified by geophysical surveying) at the east end of the Chemical Range (firing point) that were used to dispose of spent munitions following testing operations. In 1991 prior to the Rust E&I Phase I RI field investigation, the two open trenches were backfilled and graded with the berm materials surrounding the trenches. Additional geophysical surveys were required to relocate the two former trenches and confirm the location of the suspected third trench. Northwest of the firing point, TEAD-EMO identified another testing area with an open trench filled with spent and burned munitions following the Phase I RI. The rest of the firing course is relatively flat, with grass and sagebrush covering the entire SWMU. Test pits were excavated and sampled throughout the Firing Course, Northwest Test Area, and Trench Area at the firing point (see Section 5.2.2). Some of the test pits contained debris and spent or destroyed munitions. Although these munitions were not live, live UXO could possibly be present in areas where no test pits were excavated.

5.2.2 Previous Investigations and Phase I and Phase II RI Activities

Previous environmental investigations included surface soil sampling from the bermed soils adjacent to the two formerly open trenches near the Firing Point and a geophysical survey, which identified a potential third trench at the site (Weston 1990). A total of 12 surface soil samples were collected and analyzed for explosives, metals, and anions. Only nickel and zinc were present in above background concentrations. Because of safety concerns, no samples were collected from within the open trenches nor were subsurface samples collected from the soils adjacent to these trenches.

The Phase I RI field investigation activities included a geophysical survey across the eastern end of SWMU 7 designed to determine the location of the two previous open trenches and to verify the location of the potential third trench at the site. On the basis of the anomalies from the previous and Phase I RI geophysical surveys, three test-pit locations were excavated (Figure 5-5). Samples were collected to characterize the buried materials in each trench location and to determine if contaminants had been released to subsurface soils. The samples were analyzed for explosives, SVOCs, metals, and anions. The geophysical anomaly area next to the concrete building foundation, identified previously by Weston (1990) and again by Rust E&I in 1992, was excavated but no buried debris was found to be present (Test Pit 3). The

source of this geophysical anomaly is, therefore, unknown. The second test pit (Test Pit 2) was excavated within one of the former open trenches and was found to contain a variety of metal debris. The third test pit (Test Pit 1), located on the edge of one of the former trenches, contained no metal debris.

Results of the Weston sampling could not be confirmed during the Phase I RI activities since the soils that were previously sampled appear to have been used to backfill the trenches. It is also suspected that clean soils may have been used to complete the filling and grading of the former trenches. Because the exact locations of the former trenches could not be determined on the basis of the Phase I geophysical survey and test pit excavations, it was determined that additional geophysical surveying, test pit excavation, and sampling were needed to better characterize the site.

The Phase II RI field investigation at the Chemical Range addressed (1) the area next to the Firing Point, which was sampled during the Phase I RI, (2) the Northwest Test Area Trench northwest of the firing point, and (3) the Bullet Stop and Firing Course. Figure 5-6 shows the location of each of the Phase II study areas at SWMU 7. UXO clearance was required prior to and during any work performed at SWMU 7. A DANS geophysical survey, totaling approximately 50 acres in area, was conducted at these selected areas to locate potential UXO (if present), identify former trench areas (if present), and determine Phase II RI sampling locations. During the Phase II RI field investigation, only one piece of material was identified and removed by AED personnel. Final selection of the locations for test pits was based on areas of geophysical anomalies and visual identification of disturbed areas that may indicate former trenching. The results of the geophysical survey are shown in Appendix F.

On the basis of the DANS geophysical survey performed by EODT, five test pits (CRP-94-01 through CRP-94-05) and three observation pits (OBS 1, 2, and 3) were excavated within the previously sampled Firing Point area (Figure 5-7). Four soil samples were collected from each of these pits between the depths of 5 and 10 feet (generally at depths of 5, 7, 9, and 10 feet). A sixth test pit (CRP-94-15) was also excavated just west of the Firing Point area (Figure 5-7) and was sampled at three depths (0.5, 5, and 10 feet). Two surface soil samples (0.5 feet) were also collected in the vicinity of the Firing Point area (CRS-94-17 and CRS-94-18). The soil samples were analyzed for metals, explosives, and SVOCs. Also, all soils were scanned with an HnU for VOCs, but none were detected. Each of the five test pits excavated within the areas of geophysical anomalies (CRP-91-01 through CRP-94-05) contained metal debris, including spent munitions. The three observation pits were located on the boundary of the geophysical anomaly to determine the horizontal extent of the trenches.

At the Northwest Test Area Trench, seven test pits were excavated to confirm the presence or absence of subsurface contamination. The DANS geophysical survey identified a large, northwest-southeast trending, geophysical anomaly (Figure 5-8). Five test pits and one observation pit were located within this geophysical anomaly. Two test pits (11 and 12) were excavated in the newly located open trench. Three samples were collected from each of the test pits at the depths of 0.5, 5, and 10 feet. Three surface soil samples (0.5 feet) were also collected in the vicinity of the Northwest Test Area Trench (CRS-94-01 through CRS-94-03).

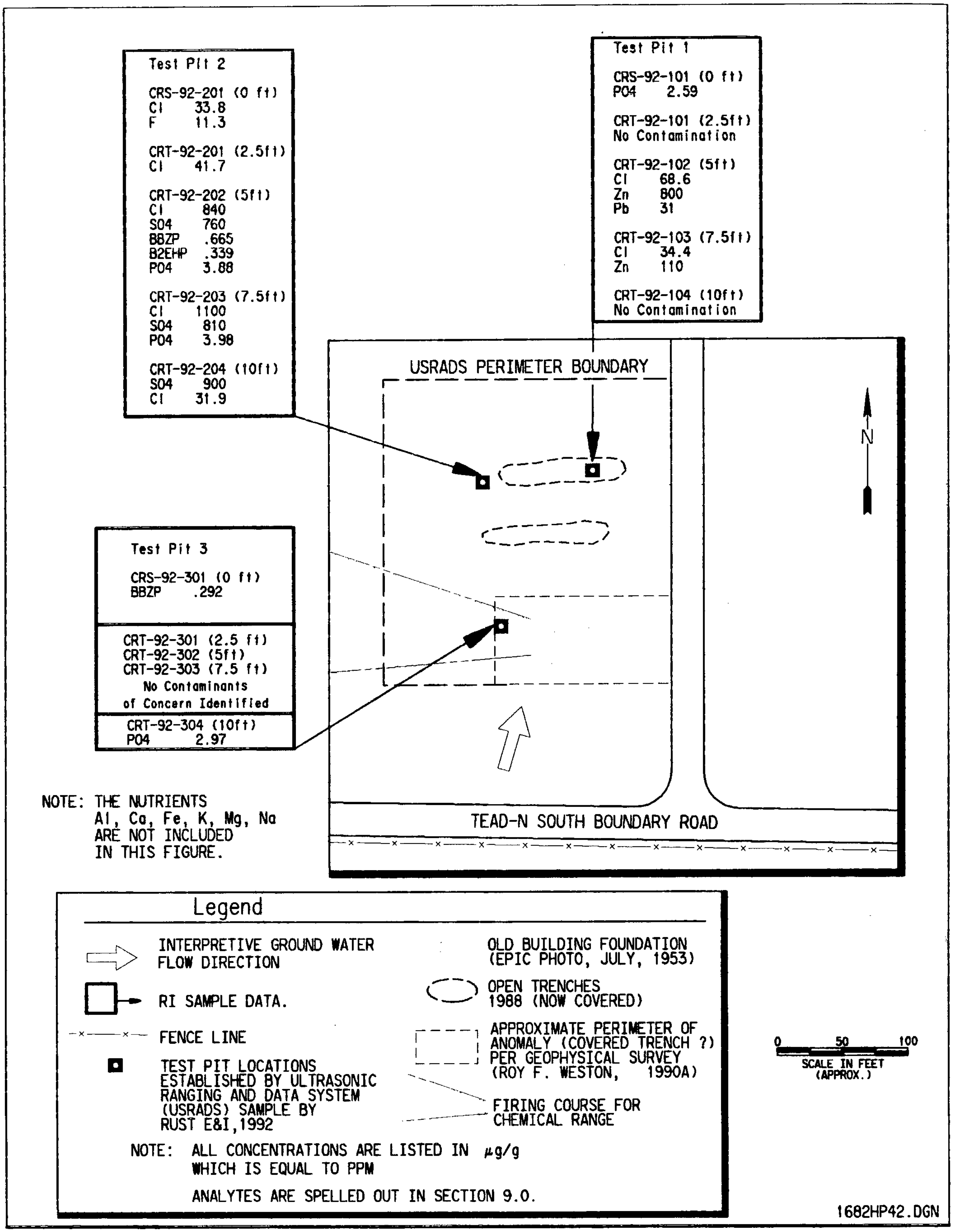


Figure 5-5. Phase I RI Test Pit Locations and Results

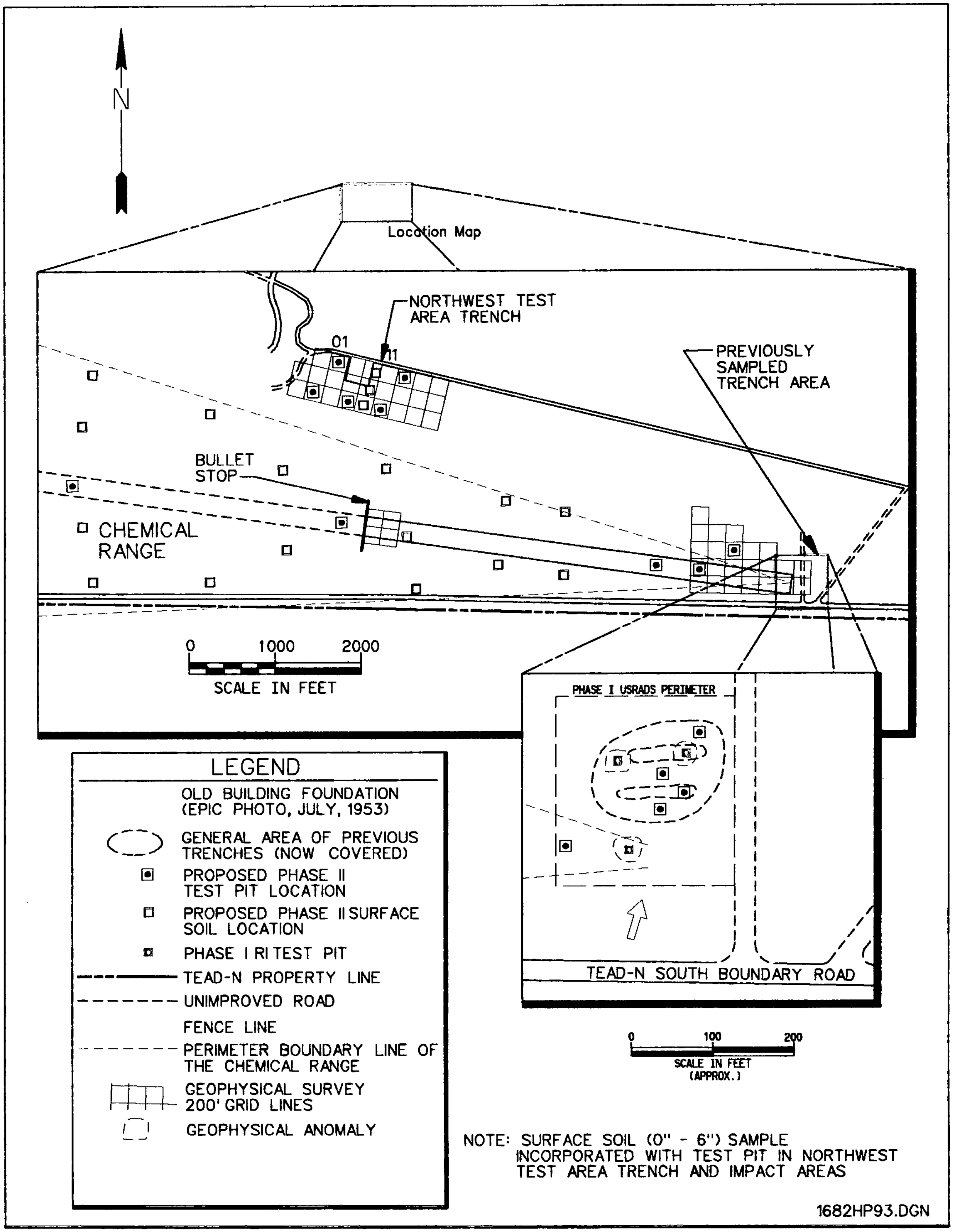
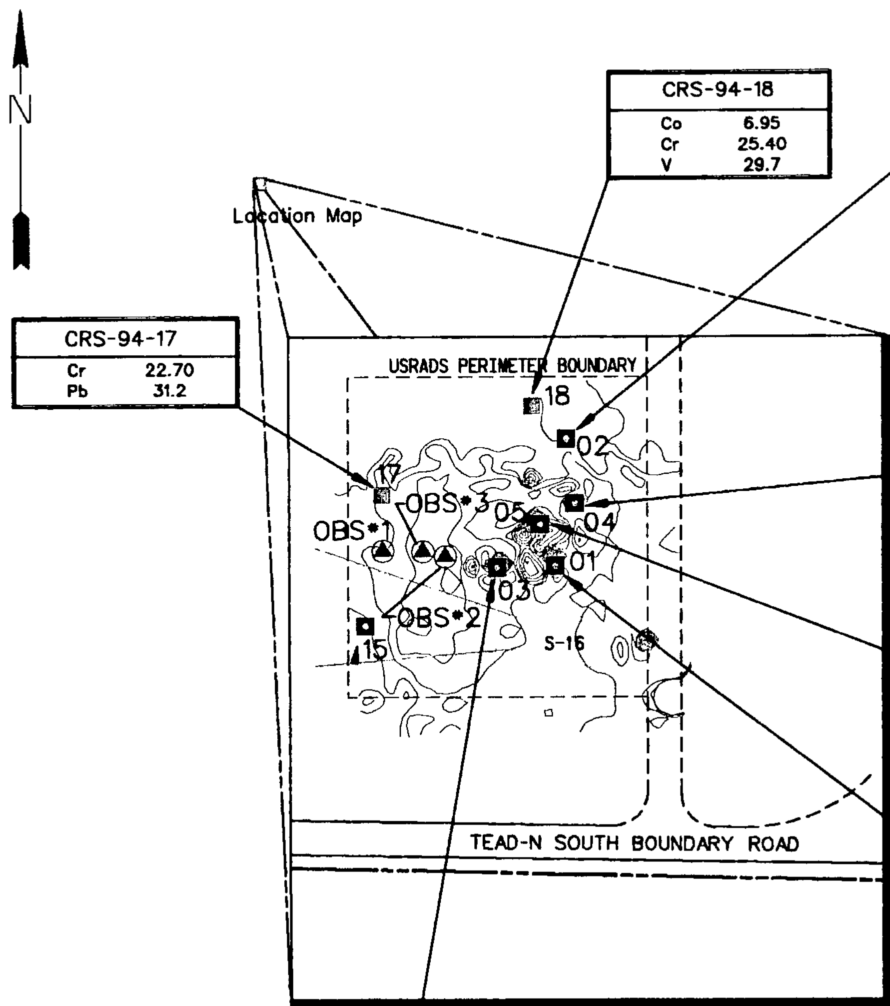


Figure 5-6. Phase II Study Areas at SWMU 7



CRS-94-18

Co	6.95
Cr	25.40
V	29.7

CRS-94-17

Cr	22.70
Pb	31.2

CRP-94-02

Analyte	Depth in feet 5	7	9	10
As	17.5	*	*	*
Cd	9.48	*	*	*
Co	7.52	*	*	8.56
Cr	*	*	*	20.70
Cu	99.60	*	*	42.50
Pb	19.6	*	*	*
V	*	*	*	29.60
Zn	12000.00	*	178.00	2500.00
BZALC	LT	0.064	LT	LT
DNBP	2.6	LT	LT	LT
Cl6BZ	0.34	LT	LT	LT

CRP-94-04

Analyte	Depth in feet 5	7	9	10
Cd	1.81	*	*	*
Zn	356.00	*	*	231.00
BZALC	0.067	0.062	0.051	0.065

CRP-94-05

Analyte	Depth in feet 4	5	7	10
Cd	21.60	12.80	*	*
Co	8.68	7.22	*	*
Zn	6300.00	5300.00	186.00	*
BZALC	0.047	0.052	LT	LT

CRP-94-01

Analyte	Depth in feet 5	7	9	10
Cd	*	*	2.63	*
Co	8.05	*	*	*
Cu	*	*	28.80	32.10
Pb	*	*	48.50	*
V	29.90	*	*	*
Zn	*	218.00	1040.00	697.00

CRP-94-03

Analyte	Depth in feet 5	7	9	10
Co	7.26	*	*	*
BZALC	0.061	0.043	LT	0.079

NOTE: ALL CONCENTRATIONS ARE LISTED IN µg/g WHICH IS EQUAL TO PPM
ANALYTES ARE SPELLED OUT IN SECTION 9.0

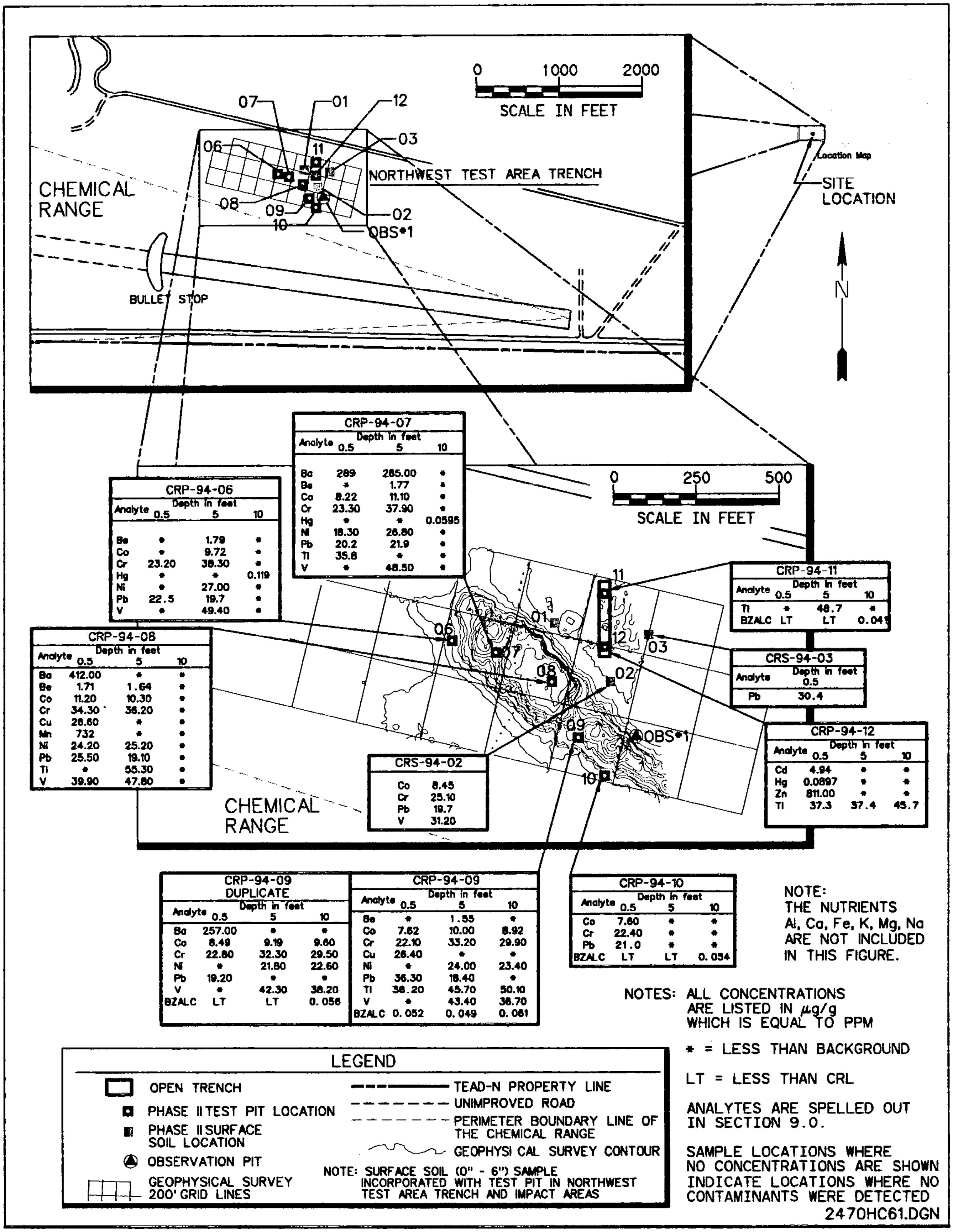
NOTE: THE NUTRIENTS Al, Ca, Fe, K, Mg, Na ARE NOT INCLUDED IN THIS FIGURE.

LEGEND

- OLD BUILDING FOUNDATION (EPIC PHOTO, JULY, 1953)
- ◘ PHASE II TEST PIT LOCATION
- ▣ PHASE II SURFACE SOIL LOCATION
- ▲ OBSERVATION PIT LOCATION
- LT LESS THAN CRL
- * LESS THAN BACKGROUND
- TEAD-N PROPERTY LINE
- UNIMPROVED ROAD
- FENCE LINE
- PERIMETER BOUNDARY LINE OF THE CHEMICAL RANGE
- GEOPHYSICAL ANOMALY CONTOUR

2470HC60.DGN

Figure 5-7. SWMU 7 Firing Point Geophysical Anomalies, Sample Locations, and Phase II Results



CRP-94-07

Analyte	Depth in feet 0.5	5	10
Ba	289	265.00	*
Be	*	1.77	*
Co	8.22	11.10	*
Cr	23.30	37.90	*
Hg	*	*	0.0595
Ni	18.30	26.80	*
Pb	20.2	21.9	*
Tl	35.8	*	*
V	*	48.50	*

CRP-94-06

Analyte	Depth in feet 0.5	5	10
Be	*	1.79	*
Co	*	9.72	*
Cr	23.20	38.30	*
Hg	*	*	0.119
Ni	*	27.00	*
Pb	22.5	19.7	*
V	*	49.40	*

CRP-94-11

Analyte	Depth in feet 0.5	5	10
Tl	*	48.7	*
BZALC	LT	LT	0.041

CRP-94-08

Analyte	Depth in feet 0.5	5	10
Ba	412.00	*	*
Be	1.71	1.64	*
Co	11.20	10.30	*
Cr	34.30	36.20	*
Cu	26.60	*	*
Mn	732	*	*
Ni	24.20	25.20	*
Pb	25.50	19.10	*
Tl	*	55.30	*
V	39.90	47.80	*

CRS-94-03

Analyte	Depth in feet 0.5
Pb	30.4

CRP-94-12

Analyte	Depth in feet 0.5	5	10
Cd	4.94	*	*
Hg	0.0897	*	*
Zn	811.00	*	*
Tl	37.3	37.4	45.7

CRS-94-02

Co	8.45
Cr	25.10
Pb	19.7
V	31.20

CRP-94-09 DUPLICATE

Analyte	Depth in feet 0.5	5	10
Ba	257.00	*	*
Co	8.49	9.19	9.60
Cr	22.80	32.30	29.50
Ni	*	21.80	22.60
Pb	19.20	*	*
V	*	42.30	38.20
BZALC	LT	LT	0.056

CRP-94-09

Analyte	Depth in feet 0.5	5	10
Be	*	1.55	*
Co	7.62	10.00	8.92
Cr	22.10	33.20	29.90
Cu	26.40	*	*
Ni	*	24.00	23.40
Pb	36.30	18.40	*
Tl	38.20	45.70	50.10
V	*	43.40	38.70
BZALC	0.052	0.049	0.061

CRP-94-10

Analyte	Depth in feet 0.5	5	10
Co	7.60	*	*
Cr	22.40	*	*
Pb	21.0	*	*
BZALC	LT	LT	0.054

Figure 5-8. Sample Locations and Phase II Results at the Northwest Test Area Trench

All soil samples were analyzed for metals, explosives, and SVOCs; also, they were scanned with an HnU for VOCs, but no VOCs were detected. No buried debris was found in the observation pit or in any of the five test pits (CRP-94-06 through -10) located within the larger geophysical anomaly that extends at least 1,300 feet to the northwest. The observation pit was excavated along the outer boundary of this geophysical anomaly.

The open trench north of the large-scale anomaly was found to be filled with various types of spent and burned munitions, shipping boxes, and other debris. The open trench is approximately 16 feet wide, 46 feet long, and 6 feet deep with a pile of the excavated soil at the northern end. A burn horizon was observed on the surface of the pit floor, indicating that some burning of debris or munitions had occurred. One test pit was excavated at each end (CRP-94-11 and CRP-94-12) of this pit with samples collected at 0.5, 5, and 10 feet to determine the presence and vertical extent of contamination.

Two test pits were also completed along the Firing Course. One was located in the impact area at the base of the Bullet Stop (CRP-94-13), one-half the distance to the Firing Point (CRP-94-14) (Figure 5-9). CRP-94-15 is included as part of the Firing Point area discussion. No debris was observed during the excavation, and soil samples were collected at 0.5, 5, and 10 feet. In addition to the 2 test pit locations along the Firing Course, 13 surface soil samples (0.5 feet) were collected from locations across the Firing Course as shown in Figure 5-9 (CRS-94-04 through CRS-94-16). All samples were analyzed for metals, explosives, and SVOCs. All soil samples were scanned with an HnU for VOCs.

5.2.3 Contamination Assessment

5.2.3.1 *Data Evaluation*

This section evaluates the analytical data for its usability in the risk assessment. A data evaluation was performed by reviewing the data quality codes assigned by the USAEC Chemistry Branch and EcoChem, an independent third-party validator. In an effort to ascertain the level of certainty/uncertainty, USEPA data qualification codes were then assigned as an aid in interpreting the data for use in the risk assessment. (Table 2-4 defines the relationship between the USAEC Chemistry Branch codes and USEPA data qualifiers.) The following sections summarize the results of this process.

5.2.3.1.1 ***Field Duplicates.*** The "D" flag code represents a field duplicate. All "D" flagged data were compared with the primary investigative result, and the higher of the two values was used in the quantitative risk assessment.

5.2.3.1.2 ***Blank Assessment.*** The USEPA has determined that when blank contamination exists, the investigative results must exceed the blank result by a factor of 5 (all compounds) or 10 (common laboratory contaminants such as acetone) in order to be considered positive. Di-

n-butylphthalate (DNBP), which is a common laboratory contaminant, and several metals were detected in method and/or rinsate blanks associated with SWMU 7 soil samples. Based on comparisons to blanks, positive results were changed to nondetects for the following samples.

According to USEPA guidance (USEPA 1989a), the associated blank concentration was considered the quantitation limit for the affected samples.

- Firing Point - Surface Soil
  -DNBP—CRP-94-15A
  -Manganese—CRP-94-15A
  -Nitrate—CRS-92-101, -201, and -301

- Firing Point - Subsurface Soil
  -DNBP—CRP-94-15B and -15C
  -Manganese—CRP-04-01D
  -Nitrate—CRT-92-101 through -304 (all 1992 subsurface samples)
  -Vanadium - CRP-94-01D and -04D

- Northwest Test Area Trench - Surface Soil
  -DNBP—CRP-94-12A
  -Aluminum—CRP-94-11A and -12A
  -Barium—CRP-94-11A and -12A
  -Iron—CRP-94-11A and -12A
  -Magnesium—CRP-94-12A
  -Manganese—CRP-94-11A and -12A
  -Potassium—CRP-94-11A and -12A
  -Vanadium—CRP-94-11A and -12A

- Northwest Test Area Trench - Subsurface Soil
  -DNBP—CRP-94-12B and -12C
  -Aluminum—CRP-94-08C, -11B, -11C, -12B, and -12C
  -Barium—CRP-94-08C, -11B, -11C, -12B, and -12C
  -Iron—CRP-94-08C, -11B, -11C, -12B, and -12C
  -Manganese—CRP-94-06C, -08C, -11B, -11C, -12B, and -12C
  -Potassium—CRP-94-06C, -08C, -11B, -11C, -12B, and -12C
  -Vanadium—CRP-94-06C, -08C, -10C, -11B, -11C, -12B, and -12C

- Bullet Stop - Surface Soil
  -DNBP—CRP-94-13A and -14A
  -Aluminum—CRP-94-14A
  -Barium—CRP-94-14A
  -Iron—CRP-94-14A
  -Manganese—CRP-94-14A
  -Potassium—CRP-94-14A
  -Vanadium—CRP-94-14A

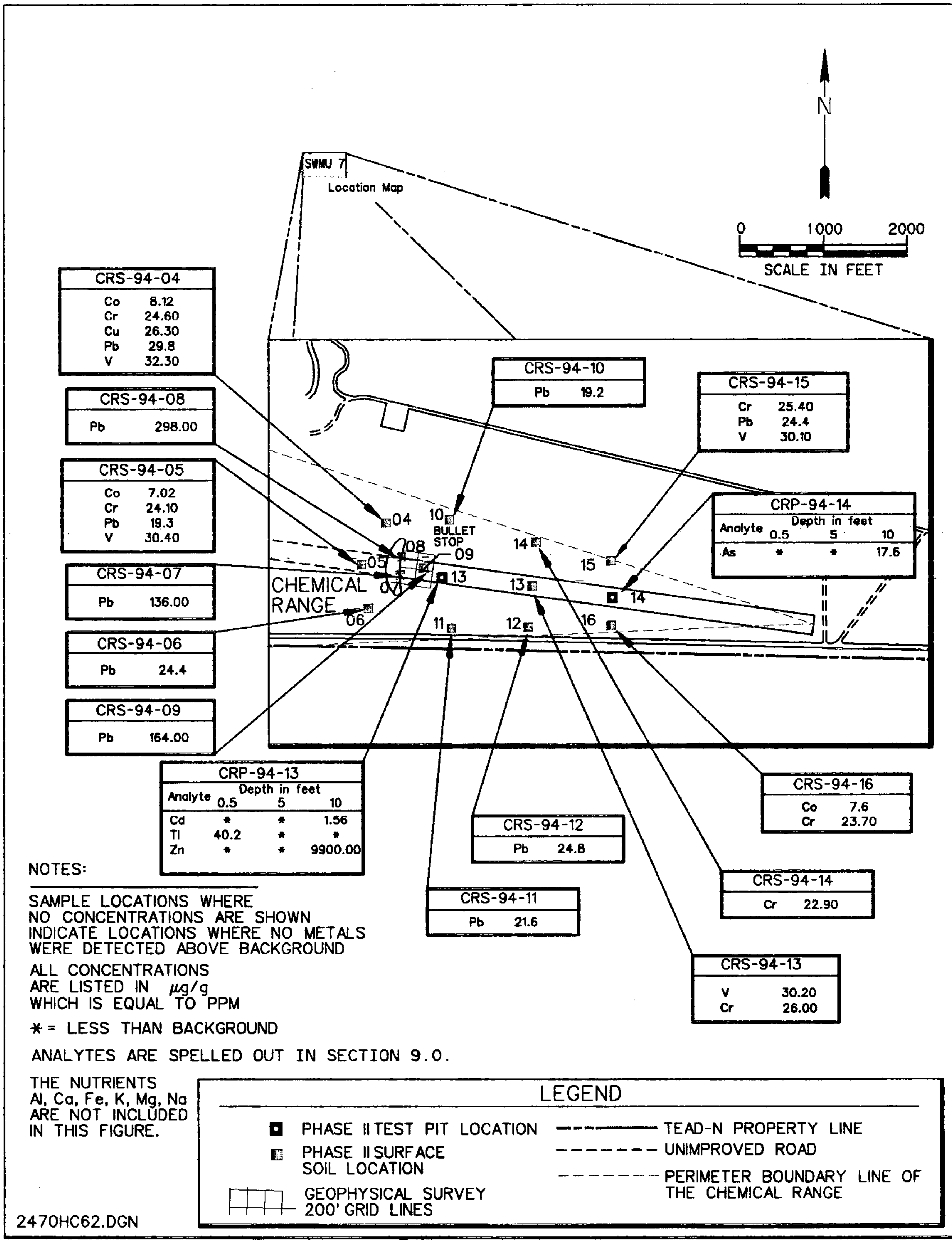


Figure 5-9. Sample Locations and Phase II Results at the Firing Course and Bullet Stop

- Bullet Stop - Subsurface Soil
  -DNBP—all four subsurface soil samples (CRP-94-13B, -13C, -14B, and -14C)
  -Aluminum—all subsurface samples
  -Barium—all subsurface samples
  -Iron—CRP-94-13C, -14B, and -14C
  -Magnesium—CRP-94-13C
  -Manganese—all subsurface samples
  -Potassium—all subsurface samples
  -Vanadium—all subsurface samples

5.2.3.1.3 ***USAEC Chemistry Branch Validation.*** The USAEC Chemistry Branch reviewed the analytical data for technical deficiencies based on the *USATHAMA (USAEC) Quality Assurance Program (PAM 11-41)*. USAEC data qualifiers assigned by the Chemistry Branch would be an indication of QC recoveries outside of USAEC control limits and other technical deficiencies. Estimating the data for use in the risk assessment based on USAEC data qualifiers is judged to be a conservative approach since USAEC control limits are generally narrower than USEPA Functional Guidelines.

For SWMU 7, the USAEC rejected all antimony detection limits in Lot ANQY because of a poor low-spike recovery. Since this indicates the possibility of false negatives, these results were rejected (R) and considered unusable for purposes of the risk assessment.

The USAEC assigned qualifiers to 1,3,5-trinitrobenzene results in Lots AMYF and ANCF and thallium results in Lot ANQY due to poor low-spike recoveries. Results less than the high concentration spike are considered biased low and estimated (J or UJ) for use in the risk assessment. RDX and nickel were also qualified by the USAEC Chemistry Branch for high low-spike recoveries. Detected values for these analytes less than the high concentration spike were estimated (J) and considered potentially biased high.

Non-Certified Compounds. USAEC flag codes of R or T were assigned by the analytical laboratory to indicate non-detected compounds that had not been performance demonstrated or validated under the USAEC's 1990 QA program. Under this program, a distinction is made between "target" and "non-target" analytes. "Target" compounds are determined during the certification process, and CRLs for these analytes are established. "Non-target" compounds are those which were added to the method to meet project-specific requirements. The lowest calibration standard typically reflects the PQL for that analyte. For the purpose of the risk assessment, the detection limit was assigned a J-code, due to the uncertainty associated with not having undergone a rigorous certification process.

5.2.3.1.4 ***Independent Third-Party Data Validation.*** A data quality assessment was completed using a validation effort by EcoChem, an independent third party. EcoChem's review and recommendations were based on USEPA Functional Guidelines as well as the *USATHAMA (USAEC) Quality Assurance Program (PAM 11-41)* and individual methods. All

USEPA data qualifiers recommended by EcoChem were incorporated for use in the risk assessment and are provided in the analytical summary tables of Appendix J.

For SWMU 7, EcoChem evaluated one lot of explosive analyses of soil samples by Method LW23 and one lot of ICP-metal analyses of soil samples by Method JS12.

EcoChem judged the explosive data in Lot ANFY to be acceptable for use without qualification.

For the ICP-metal analyses, Lot ANUC, EcoChem rejected the quantitation limits for antimony due to poor MS/MSD recoveries. All other data were determined to be acceptable without qualification.

Listed below are all sample results in SWMU 7 that were rejected for use in the risk assessment based data qualifiers assigned by EcoChem and the USAEC Chemistry Branch.

- Surface Samples
  -Antimony—CRS-94-01 through 18 and CRP-94-06A, -07A, -08A, -09A and dup, -10A, -11A, -12A, -13A, -14A, -15A
- Subsurface Samples
  -Antimony—CRP-94-06B, -06C, -07B, 07C, -08B, -08C, -09B and dup, -09C and dup, -10B, -10C, -11B, -11C, -12B, -12C, -13B, -13C, -14B, -14C, -15B, -15C

5.2.3.1.5 ***Data Evaluation Summary.*** A total of 31 surface soil samples (and 1 duplicate) and 56 subsurface soil samples (and 2 duplicates) were collected in 1992 and 1994 from 18 test pits and 21 surface locations at SWMU 7. Subsurface samples were collected at depths of 2 to 10 feet. Samples were analyzed for one or more of the following groups of chemicals: semivolatiles, anions, metals, and explosives.

Because of blank contamination, positive results for a number of metals were changed to nondetects. However, in every case, the detected value in the affected sample was below the background screening level for the metal. Therefore, this issue does not significantly impact the risk assessment results.

The following metals were not detected within surface or subsurface soil in at least one area of concern, yet their reporting limits exceeded their background screening values: antimony, cadmium, silver, and thallium. The high reporting limits for cadmium (1.2 $\mu g/g$) and silver (0.80 $\mu g/g$) were less than their respective ingestion and soil-to-air RBCs, however. Therefore, this issue does not significantly impact the risk assessment results for these chemicals.

The thallium reporting limits ranged from 34.3 $\mu g/g$ to 170 $\mu g/g$, which exceed the background value of 11.7 $\mu g/g$. Several thallium results were reported as not detected at or above these elevated reporting limits. Thallium was detected above background in several surface and subsurface samples in the Northwest Trench Area and in one surface sample at the

Bullet Stop. As part of the FS process, Dames and Moore (1996) calculated PRGs for current use scenarios that are significantly higher (98.1 to 1330 μg/g) than the elevated reporting limits noted above. Therefore, under current use conditions the thallium data are usable and no data gap exists. However, additional thallium data may be necessary before releasing this SWMU for any future residential land use.

As with thallium, Dames and Moore calculated current use antimony PRGs (136 to 467 μg/g), which exceed the elevated reporting limits noted above. Therefore, no data gap exists under current use conditions. However, additional antimony data may be necessary prior to pursuing any future residential land use.

Antimony was not detected in any surface or subsurface samples at this SWMU. With the exception of one 1992 sample, the antimony reporting limit ranged from 17 to 34 μg/g, which exceeds the background screening value of 15 μg/g. In addition, 48 antimony nondetect results were rejected due to poor recovery in matrix spikes. The PRGs calculated by Dames and Moore (1996) of 136 to 467 μg/g for current land use conditions are higher than the above-note reporting limits indicating no data gap exists under current conditions. Additional sampling would likely be required prior to release for residential land use.

Approximately 99 percent of sample results were judged to be usable for risk assessment purposes. In general, the number of samples and the analytical parameter list appear to be sufficient to characterize the nature, extent, and potential magnitude of contamination at this SWMU with the exceptions as noted above. A summary of chemicals detected in at least one surface or subsurface sample at SMWU 7 is presented in Appendix J, including corresponding data qualifiers (as appropriate) according to USEPA functional guidelines.

5.2.3.1.6 ***Background Screening.*** The maximum concentrations of inorganic chemicals detected in soil within each area of concern at SWMU 7 were compared to the site-specific background screening values (see Section 2.6). Any inorganic chemical detected in at least one sample at a concentration higher than the background screening value was retained in the COPC database. Surface soil and subsurface soil were screened separately. The results of the background screening are shown in Table 5-43.

Firing Point. Based on the background screening analysis, chromium, cobalt, lead, magnesium, potassium, sodium, and vanadium were retained as preliminary COPCs in surface soil at the Firing Point. Although all arsenic detect values (range 3.25 to 5.24 μg/g) were below the background threshold value (11.69 μg/g), the three nondetect samples collected in 1992 had CRLs higher than the background value (range of CRLs = 48 to 240).

Cadmium was not detected in surface soil; however, the cadmium CRL (1.2 μg/g) was higher than the background screening value (0.847 μg/g). All silver values were below the background value for this metal, but the three samples collected in 1994 had a CRL (0.803 μg/g) higher than the background threshold value for silver (0.66 μg/g).

Thallium was not detected in surface soil at the Firing Point; however, the CRLs ranged from 34.3 to 170 μg/g, compared to the background threshold value for thallium of 11.7 μg/g.

Table 5-43. Background Screening of Inorganic Chemicals Detected in Soil at SWMU 7

Chemical	Frequency of Detection[a]	Maximum Detected Value (μg/g)	Site-specific Background Screening Value[b] (μg/g)	Exceeds Site-specific Background?
Firing Point - Surface Soil				
Aluminum	3/3	23,200	28,083	No
Arsenic	3/6	5.24	11.69	No
Barium	6/6	147	247	No
Beryllium	3/6	0.718	1.46	No
Calcium	3/3	19,600	114,483	No
Chromium	6/6	25.4	20.62	**YES**
Cobalt	3/3	6.95	6.94	**YES**
Copper	6/6	22.1	24.72	No
Iron	6/6	19,600	22,731	No
Lead	5/6	31.2	18.23	**YES**
Magnesium	3/3	8,780	7,062	**YES**
Manganese	2/3	480	698	No
Nickel	3/6	13.2	17.40	No
Potassium	3/3	6,450	5,450	**YES**
Silver	3/6	0.0692	0.66	No
Sodium	3/3	3,850	337	**YES**
Vanadium	3/3	29.7	28.39	**YES**
Zinc	6/6	64	102.8	No
Firing Point - Subsurface Soil				
Aluminum	22/22	20,100	28,083	No
Arsenic	22/34	17.5	11.69	**YES**
Barium	34/34	190	247	No
Beryllium	17/34	1.02	1.46	No
Cadmium	5/34	21.6	0.847	**YES**
Calcium	22/22	45,100	114,483	No
Chromium	33/34	20.7	20.62	**YES**
Cobalt	22/22	8.68	6.94	**YES**
Copper	34/34	99.6	24.72	**YES**
Iron	34/34	25,100	22,731	**YES**
Lead	15/34	48.5	18.23	**YES**
Magnesium	22/22	7,390	7,062	**YES**
Manganese	21/22	508	698	No
Nickel	22/34	16.8	17.40	No
Potassium	22/22	4,600	5,450	No
Silver	12/34	0.0484	0.66	No
Sodium	22/22	2,070	337	**YES**
Vanadium	20/22	29.9	28.39	**YES**

Table 5-43. Background Screening of Inorganic Chemicals Detected in Soil at SWMU 7 (continued)

Chemical	Frequency of Detection[a]	Maximum Detected Value (μg/g)	Site-specific Background Screening Value[b] (μg/g)	Exceeds Site-specific Background?
Zinc	34/34	12,000	102.8	YES
Northwest Test Area Trench - Surface Soil				
Aluminum	8/10	39,800	28,083	YES
Arsenic	9/10	9.49	11.69	No
Barium	8/10	412	247	YES
Beryllium	7/10	1.71	1.46	YES
Cadmium	1/10	4.94	0.847	YES
Calcium	10/10	100,000	114,483	No
Chromium	10/10	34.3	20.62	YES
Cobalt	9/10	11.2	6.94	YES
Copper	10/10	26.6	24.72	YES
Iron	8/10	35,000	22,731	YES
Lead	9/10	36.3	18.23	YES
Magnesium	9/10	21,300	7,062	YES
Manganese	8/10	732	698	YES
Mercury	2/10	0.0897	0.0572	YES
Nickel	10/10	24.2	17.40	YES
Potassium	8/10	15,700	5,450	YES
Sodium	10/10	1,240	337	YES
Thallium	3/10	38.2	11.70	YES
Vanadium	8/10	39.9	28.39	YES
Zinc	10/10	811	102.8	YES
Northwest Test Area Trench - Subsurface Soil				
Aluminum	9/14	42,400	28,083	YES
Arsenic	11/14	11.6	11.69	No
Barium	9/14	265	247	YES
Beryllium	10/14	1.79	1.46	YES
Calcium	14/14	140,000	114,483	YES
Chromium	14/14	38.3	20.62	YES
Cobalt	11/14	11.1	6.94	YES
Copper	13/14	24.2	24.72	No
Iron	9/14	36,500	22,731	YES
Lead	10/14	21.9	18.23	YES
Magnesium	14/14	14,000	7,062	YES
Manganese	9/14	557	698	No
Mercury	2/14	0.119	0.0572	YES
Nickel	13/14	27.0	17.40	YES
Potassium	8/14	10,600	5,450	YES

Table 5-43. Background Screening of Inorganic Chemicals Detected in Soil at SWMU 7 (continued)

Chemical	Frequency of Detection[a]	Maximum Detected Value (μg/g)	Site-specific Background Screening Value[b] (μg/g)	Exceeds Site-specific Background?
Sodium	14/14	6,840	337	**YES**
Thallium	6/14	55.3	11.70	**YES**
Northwest Test Area Trench - Subsurface Soil (continued)				
Vanadium	7/14	49.4	28.39	**YES**
Zinc	14/14	89.3	102.8	No
Bullet Stop - Surface Soil				
Aluminum	14/15	22,600	28,083	No
Arsenic	15/15	8.64	11.69	No
Barium	14/15	201	247	No
Beryllium	7/15	0.737	1.46	No
Calcium	15/15	44,300	114,483	No
Chromium	15/15	26.0	20.62	**YES**
Cobalt	14/15	8.12	6.94	**YES**
Copper	14/15	26.3	24.72	**YES**
Iron	14/15	22,300	22,731	No
Lead	14/15	298	18.23	**YES**
Magnesium	15/15	11,700	7,062	**YES**
Manganese	14/15	632	698	No
Nickel	15/15	14.5	17.40	No
Potassium	14/15	6,960	5,450	**YES**
Sodium	15/15	614	337	**YES**
Thallium	1/15	40.2	11.70	**YES**
Vanadium	14/15	32.3	28.39	**YES**
Zinc	15/15	71.2	102.8	No
Bullet Stop - Subsurface Soil				
Arsenic	4/4	17.6	11.69	**YES**
Cadmium	1/4	1.56	0.847	**YES**
Calcium	4/4	20,900	114,483	No
Chromium	4/4	4.77	20.62	No
Copper	2/4	7.0	24.72	No
Iron	1/4	6,850	22,731	No
Magnesium	3/4	2,010	7,062	No
Nickel	3/4	4.19	17.40	No
Sodium	4/4	302	337	No
Zinc	4/4	9,900	102.8	**YES**

Note.—All values are in micrograms per gram (μg/g).
[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]See Section 2.6.1.1 for an explanation of how the site-specific background screening values were calculated.

In subsurface soil, arsenic, cadmium, chromium, cobalt, copper, iron, lead, magnesium, sodium, vanadium, and zinc were above background threshold values and were retained as preliminary COPCs. As with surface soil, all silver and thallium analytical results were either nondetect or detects below background threshold values. However, nondetect values had high CRLs which exceeded the background values for these metals.

Northwest Test Area Trench. At the Northwest Test Area Trench, with the exception of arsenic and calcium, all inorganic chemicals detected in surface soil were above background threshold values and were retained as preliminary COPCs. Silver was not detected in surface soil; however, the CRL (0.803 μg/g) was above the background threshold value (0.66 μg/g). In subsurface soil, all detected inorganic chemicals except arsenic, copper, manganese, and zinc were retained as preliminary COPCs. Cadmium and silver were not detected, but had CRLs which exceeded the background threshold values.

Bullet Stop. In surface soil at the Bullet Stop, chromium, cobalt, copper, lead, magnesium, potassium, sodium, thallium, and vanadium were above background threshold values and were retained as preliminary COPCs. Cadmium and silver were not detected, but had CRLs which exceeded the background threshold values.

In subsurface soil, only arsenic, cadmium, and zinc were retained as preliminary COPCs. Silver and thallium, which were not detected, had CRLs which exceeded the background threshold values.

5.2.3.2 *Summary of Analytical Results*

The list of analytes detected in at least one surface or subsurface soil sample within each area of concern is provided in Table 5-44 for Phase I data and Table 5-45 for Phase II data. The complete data set is contained in Appendix H.

5.2.3.3 *Nature and Extent of Contamination*

This section has been broken into the following three areas to aid in describing the source and extent of contamination at SWMU 7: (1) the Firing Point, (2) the Northwest Test Area Trench, and (3) the Bullet Stop and Firing Course. No explosive contamination was detected in any of the samples from SWMU 7. All soils at SWMU 7 were scanned with an HnU for VOCs, but none were detected. Test pit logs showing lithology, materials encountered, and sample locations/depths are presented in Appendix B.

5.2.3.3.1 ***Firing Point.*** The firing point is located at the east end of the Chemical Range. Three test pits were excavated at the Firing Point during Phase I. Test Pit 1 was located north of the building foundation in a target area identified by the geophysical survey. This test pit was found to contain burned metal debris, including munition containers, slap flares, smoke flares, and trip flares. In spite of the buried materials present, only two metals were detected

Table 5-44. *Summary of Analytes Detected in Soil for the Chemical Range (SWMU 07) - Phase I*

Firing Point Area (Surface Soil)

Group	Analytes	Background Concentrations	CRS-92-101 (0ft)	CRS-92-201 (0ft)	CRS-92-301 (0ft)
METALS	BARIUM	247.1	130	140	130
	CHROMIUM	20.62	16.6	17.6	14
	COPPER	24.72	9.75	8.4	8.48
	IRON	22731	17000	19000	19000
	LEAD	18.23	8.4	11	7
	SILVER	0.66	0.0692	0.0524	0.0497
	ZINC	102.8	64	45	45
SEMIVOLATILES	BUTYLBENZYL PHTHALATE	N/A	ND 0.33	ND 0.33	0.292*
ANIONS	CHLORIDE	N/A	LT 39.6	33.8*	LT 39.6
	FLUORIDE	N/A	LT 19.2	11.3*	LT 19.2
	PHOSPHATE	N/A	2.59*	ND 5	ND 5

Firing Point Area (Subsurface Soil)

Group	Analytes	Background Concentrations	CRT-92-101 (2ft)	CRT-92-101 (2.5ft)	CRT-92-102 (5ft)	CRT-92-103 (7.5ft)	CRT-92-104 (10ft)	CRT-92-201 (2.5ft)	CRT-92-201 (3ft)	CRT-92-202 (5ft)	CRT-92-202 (5.5ft)	CRT-92-203 (7.5ft)	CRT-92-204 (10ft)	CRT-92-301 (2.5ft)
METALS	BARIUM	247.1	130	NT	140	110	45	NT	190	NT	130	120	45	120
	CHROMIUM	20.62	15.1	NT	17.5	12.6	5.41	NT	18.3	NT	14.9	14.3	LT 3.9	12.9
	COPPER	24.72	6.62	NT	16.3	7.32	6.26	NT	7.63	NT	6.05	6.11	2.44	5.92
	IRON	22731	16000	NT	22000	15000	8200	NT	21000	NT	16000	15000	4900	16000
	LEAD	18.23	14	NT	31*	9.4	4.9	NT	11	NT	8.7	8.9	4.8	12
	SILVER	0.66	0.0461	NT	0.0389	0.0277	0.0166	NT	0.0484	NT	0.0231	0.0284	0.0166	0.0289
	ZINC	102.8	37	NT	800*	110*	88	NT	46	NT	36	37	10.9	34
SEMIVOLATILES	BIS (2-ETHYHEXYL) PHTHALATE	N/A	LT 0.39	NT	LT 0.39	LT 0.39	LT 0.39	NT	LT 0.39	NT	0.339*	LT 0.39	LT 0.39	LT 0.39
	BUTYLBENZYL PHTHALATE	N/A	ND 0.33	NT	ND 0.33	ND 0.33	ND 0.33	NT	ND 0.33	NT	0.665*	ND 0.33	ND 0.33	ND 0.33
ANIONS	CHLORIDE	N/A	NT	172*	68.6*	34.4*	LT 39.6	41.7*	NT	840*	NT	1100*	31.9*	LT 39.6
	PHOSPHATE	N/A	NT	ND 5	ND 5	ND 5	ND 5	ND 5	NT	3.88*	NT	3.98*	ND 5	ND 5
	SULFATE	N/A	NT	121#	23.1#	16.6#	LT 14.4	35.6#	NT	760*	NT	810*	900*	LT 14.4

Group	Analytes	Background Concentrations	CRT-92-302 (5ft)	CRT-92-303 (7.5ft)	CRT-92-304 (10ft)
METALS	BARIUM	247.1	130	120	110
	CHROMIUM	20.62	13.1	12.1	11.9
	COPPER	24.72	7.11	6.33	6.82
	IRON	22731	24000*	15000	16000
	LEAD	18.23	11	9.7	10
	SILVER	0.66	0.0277	0.0305	0.0293
	ZINC	102.8	42	37	39
SEMIVOLATILES	BIS (2-ETHYHEXYL) PHTHALATE	N/A	LT 0.39	LT 0.39	LT 0.39
	BUTYLBENZYL PHTHALATE	N/A	ND 0.33	ND 0.33	ND 0.33
ANIONS	CHLORIDE	N/A	LT 39.6	LT 39.6	LT 39.6
	PHOSPHATE	N/A	ND 5	ND 5	2.97*
	SULFATE	N/A	LT 14.4	30.3#	53.7#

Note.- All values in $\mu g/g$ (equal to ppm).
N/A = Not Applicable.
ND = Analyte not detected above the MDL, the MDL is posted next to the "ND".
LT = Analyte concentration is less than CRL, the CRL is posted next to the "LT".
* = Organic analyte detected above CRL or MDL or detected inorganic analyte exceeding background.
NT = Not Tested.
# = Analyte was detected in the associated blank in excess of the 5 or 10 times rule (as described in Section 3.1.1.1).

Table 5-45. Summary of Analytes Detected in Soil for the Chemical Range (SWMU 07) - Phase II

Firing Point Area (Surface Soil)

Group	Analytes	Background Concentrations	CRP-94-15A (0.5ft)	CRS-94-17 (0.5ft)	CRS-94-18 (0.5ft)
METALS	ALUMINUM	28083	12700	19700	23200
	ARSENIC	11.69	3.25	5.08	5.24
	BARIUM	247.1	93.6	143	147
	BERYLLIUM	1.455	0.556	0.539	0.718
	CALCIUM	114483	19600	13100	15600
	CHROMIUM	20.62	13.9	22.7*	25.4*
	COBALT	6.94	3.51	6.84	6.95*
	COPPER	24.72	7.35	22.1	14.2
	IRON	22731	13600	17300	19600
	LEAD	18.23	LT 7.44	31.2*	11.7
	MAGNESIUM	7061	5970	7780*	8780*
	MANGANESE	698.3	126#	480	455
	NICKEL	17.4	11.5	11.4	13.2
	POTASSIUM	5449	2060	5670*	6450*
	SODIUM	337	3850*	358*	331
	VANADIUM	28.39	21.5	26.6	29.7*
	ZINC	102.8	28.2	61.5	56.2

Bullet Stop (Surface Soil)

		Background Concentrations	CRP-94-13A (0.5ft)	CRP-94-14A (0.5ft)	CRS-94-04 (0.5ft)	CRS-94-05 (0.5ft)	CRS-94-06 (0.5ft)	CRS-94-07 (0.5ft)	CRS-94-08 (0.5ft)	CRS-94-09 (0.5ft)	CRS-94-10 (0.5ft)	CRS-94-11 (0.5ft)	CRS-94-12 (0.5ft)
METALS	ALUMINUM	28083	18100	1440#	22100	22600	18500	17600	16100	10500	11800	15100	16100
	ARSENIC	11.69	5.42	8.64	5.64	6.24	5.42	5.05	6.02	4.18	3.95	4.34	5.39
	BARIUM	247.1	136	13.8#	194	201	172	147	141	99.5	98.5	124	124
	BERYLLIUM	1.455	0.737	LT 0.427	0.65	0.617	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427
	CALCIUM	114483	36300	34900	6290	20400	20200	21400	19400	16200	10700	9520	34400
	CHROMIUM	20.62	17.7	3.49	24.6*	24.1*	20.2	20.6	17.7	11.8	13.5	17.3	19.4
	COBALT	6.94	5.67	LT 2.5	8.12*	7.02*	5.68	5.57	5.66	4.32	4.61	5.15	5.42
	COPPER	24.72	14.1	LT 2.84	26.3*	20.7	20.6	18.2	19.5	22.1	14	17	19.9
	IRON	22731	17600	4240#	22300	20000	16600	16700	16500	11100	12700	15600	15900
	LEAD	18.23	12.8	LT 7.44	29.8*	19.3*	24.4*	136*	298*	164*	19.2*	21.6*	24.8*
	MAGNESIUM	7061	9740*	2150	9140*	10900*	9130*	7650*	6190	4180	5540	7370*	7880*
	MANGANESE	698.3	375	53.9#	632	615	520	400	369	237	288	390	377
	NICKEL	17.4	14	3.63	13.2	11.1	10.1	9.87	9.8	7.1	6.9	9.74	12.5
	POTASSIUM	5449	5700*	371#	6450*	6920*	5860*	5280	4640	2730	3070	4340	4420
	SODIUM	337	277	126	574*	528*	518*	421*	385*	374*	424*	444*	433*
	THALLIUM	11.7	40.2*	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3
	VANADIUM	28.39	22.3	4.45#	32.3*	30.4*	26	26.2	24.6	15.8	18	21.5	23.5
	ZINC	102.8	50.2	38.7	71.2	66.5	59.1	49.4	49.5	34.5	39.4	50.4	52.2

Table 5-45. Summary of Analytes Detected in Soil for the Chemical Range (SWMU 07) - Phase II (continued)

Bullet Stop (Surface Soil)

Group	Analytes	Background Concentrations	CRS-94-13 (0.5ft)	CRS-94-14 (0.5ft)	CRS-94-15 (0.5ft)	CRS-94-16 (0.5ft)
METALS	ALUMINUM	28083	21600	19200	21000	21400
	ARSENIC	11.69	4.8	5.23	4.59	4.54
	BARIUM	247.1	150	140	173	190
	BERYLLIUM	1.455	0.649	0.582	0.562	0.695
	CALCIUM	114483	44300	32900	27400	26000
	CHROMIUM	20.62	26*	22.9*	25.4*	23.7*
	COBALT	6.94	6.56	6.45	6.63	7.6*
	COPPER	24.72	14.8	17.1	20.4	17.6
	IRON	22731	19400	18000	19300	20000
	LEAD	18.23	12.2	15.9	24.4*	16.5
	MAGNESIUM	7061	9680*	9580*	11200*	11700*
	MANGANESE	698.3	418	444	502	602
	NICKEL	17.4	14.5	13.3	11.9	13.8
	POTASSIUM	5449	6440*	5530*	6600*	6960*
	SODIUM	337	372*	427*	573*	614*
	THALLIUM	11.7	LT 34.3	LT 34.3	LT 34.3	LT 34.3
	VANADIUM	28.39	30.2*	25.6	30.1*	27.3
	ZINC	102.8	56	56.5	61.7	61.4

Northwest Test Area Trench (Surface Soil)

		Background Concentrations	CRP-94-06A (0.5ft)	CRP-94-07A (0.5ft)	CRP-94-08A (0.5ft)	CRP-94-09A (0.5ft)	CRP-94-09A(D) (0.5ft)	CRP-94-10A (0.5ft)	CRP-94-11A (0.5ft)	CRP-94-12A (0.5ft)	CRS-94-01 (0.5ft)	CRS-94-02 (0.5ft)	CRS-94-03 (0.5ft)
METALS	ALUMINUM	28083	23700	26300	39800*	23600	26500	24600	1160#	274#	12600	23100	13600
	ARSENIC	11.69	7.21	7	5.62	5.71	LT 2.5	6.09	LT 2.5	9.49	4.79	7.09	4.95
	BARIUM	247.1	220	289*	412*	212	257*	227	11.2#	26#	107	189	130
	BERYLLIUM	1.455	1.11	1.17	1.71*	0.945	1.11	1.05	LT 0.427	LT 0.427	0.631	1.15	LT 0.427
	CADMIUM	0.847	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	4.94*	LT 1.2	LT 1.2	LT 1.2
	CALCIUM	114483	47400	46300	49500	34800	47800	35700	100000	4900	7030	29700	10400
	CHROMIUM	20.62	23.2*	23.3*	34.3*	22.1*	22.8*	22.4*	1.28	5.41	15	25.1*	14.5
	COBALT	6.94	6.53	8.22*	11.2*	7.62*	8.49*	7.6*	LT 2.5	2.66	5.23	8.45*	5.56
	COPPER	24.72	20.8	21.6	26.6*	26.4*	21.5	21	4.03	10.1	15.3	20.8	21.5
	IRON	22731	23200*	25600*	35000*	21400	24800*	24300*	1680#	1090#	14700	21700	15100
	LEAD	18.23	22.5*	20.2*	25.5*	36.3*	19.2*	21*	LT 7.44	10.8	16.6	19.7*	30.4*
	MAGNESIUM	7061	14600*	16300*	21300*	13800*	16000*	15500*	901	469#	5100	12200*	6980
	MANGANESE	698.3	589	649	732*	637	611	646	34.5#	16.8#	318	514	382
	MERCURY	0.0572	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	0.0897*	0.0534	LT 0.05	LT 0.05
	NICKEL	17.4	16.5	18.3*	24.2*	15.8	17.2	16.7	4.53	5.81	8.99	15	8.96
	POTASSIUM	5449	9250*	10700*	15700*	9300*	10900*	11100*	339#	750#	3370	7220*	3860
	SODIUM	337	657*	731*	961*	780*	912*	1240*	56.6	75.6	326	501*	514*
	THALLIUM	11.7	LT 34.3	35.8*	LT 34.3	38.2*	LT 34.3	LT 34.3	LT 34.3	37.3*	LT 34.3	LT 34.3	LT 34.3
	VANADIUM	28.39	27.8	27.4	39.9*	27.8	28	26	2.08#	5.01#	19	31.2*	19.1
	ZINC	102.8	73	78.4	99.9	70	72.2	73.4	11.1	811*	43.1	67.8	49.4
SEMIVOLATILES	BENZYL ALCOHOL	N/A	LT 0.032	LT 0.032	LT 0.032	0.052*	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032

Table 5-45. Summary of Analytes Detected in Soil for the Chemical Range (SWMU 07) - Phase II (continued)

Firing Point Area (Subsurface Soil)

Group	Analytes	Background Concentrations	CRP-94-01A (5ft)	CRP-94-01B (7ft)	CRP-94-01C (9ft)	CRP-94-01D (10ft)	CRP-94-02A (5ft)	CRP-94-02B (7ft)	CRP-94-02C (9ft)	CRP-94-02D (10ft)	CRP-94-03A (5ft)	CRP-94-03B (7ft)	CRP-94-03C (9ft)
METALS	ALUMINUM	28083	17600	10800	12700	4630	17800	15900	13500	20100	16200	17000	9420
	ARSENIC	11.69	5.67	4.77	5.85	3.58	17.5*	5.02	4.29	6.2	6.1	6.07	3.92
	BARIUM	247.1	139	89.4	126	46.6	123	111	103	148	119	135	86.2
	BERYLLIUM	1.455	0.842	0.562	0.657	LT 0.427	0.701	0.73	0.736	1.02	0.742	LT 0.427	LT 0.427
	CADMIUM	0.847	LT 1.2	LT 1.2	2.63*	LT 1.2	9.48*	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2
	CALCIUM	114483	39500	19800	25200	14500	23600	27200	27500	27900	32200	25300	19300
	CHROMIUM	20.62	17.6	11.4	18.8	5.66	19.2	16.5	14	20.7*	15.8	15.8	10.7
	COBALT	6.94	8.05*	5.17	6.39	3.06	7.52*	6.7	6.06	8.56*	7.26*	6.93	5.18
	COPPER	24.72	10.1	12.2	28.8*	32.1*	99.6*	7.7	11.5	42.5*	9.7	8.73	4.28
	IRON	22731	18100	13200	22300	10200	25100*	15200	12900	24200*	15800	15100	9600
	LEAD	18.23	LT 7.44	LT 7.44	48.5*	LT 7.44	19.6*	LT 7.44	LT 7.44	12.5	LT 7.44	LT 7.44	LT 7.44
	MAGNESIUM	7061	7280*	5390	5470	2300	6740	6420	5070	7390*	7210*	6270	4220
	MANGANESE	698.3	381	287	326	133#	448	357	289	413	364	332	288
	NICKEL	17.4	13.3	9.35	11.9	4.96	15.5	11.3	10.9	15.2	12.2	11.5	7.91
	POTASSIUM	5449	4260	2650	2860	1080	4370	3290	2690	4480	3830	3810	2070
	SODIUM	337	333	300	281	195	249	488*	502*	312	1030*	2070*	996*
	VANADIUM	28.39	29.9*	19.1	20.7	9.88#	26.2	24	21.5	29.6*	23.9	25.1	16.2
	ZINC	102.8	47.7	218*	1040*	697*	12000*	51.7	178*	2500*	43.8	39.7	27.9
SEMIVOLATILES	BENZYL ALCOHOL	N/A	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032	0.064*	LT 0.032	LT 0.032	0.061*	0.043*	LT 0.032
	DI-N-BUTYL PHTHALATE	N/A	LT 1.3	LT 1.3	LT 1.3	LT 1.3	2.6*	LT 1.3	LT 1.3	LT 1.3	LT 1.3	LT 1.3	LT 1.3
	HEXACHLOROBENZENE	N/A	LT 0.08	LT 0.08	LT 0.08	LT 0.08	0.34*	LT 0.08	LT 0.08	LT 0.08	LT 0.08	LT 0.08	LT 0.08

Group	Analytes	Background Concentrations	CRP-94-03D (10ft)	CRP-94-04A (5ft)	CRP-94-04B (7ft)	CRP-94-04C (9ft)	CRP-94-04D (10ft)	CRP-94-05A (4ft)	CRP-94-05B (5ft)	CRP-94-05C (7ft)	CRP-94-05D (10ft)	CRP-94-15B (5ft)	CRP-94-15C (10ft)
METALS	ALUMINUM	28083	17100	17300	12300	10600	7410	16700	16200	16200	14400	14500	7970
	ARSENIC	11.69	5.14	4.55	5.23	4.26	3.86	5.53	5.57	5.02	4.5	4.84	4.1
	BARIUM	247.1	138	149	83.9	83.3	64.7	152	136	125	116	86.2	72.9
	BERYLLIUM	1.455	0.736	0.761	0.613	LT 0.427	0.521	0.848	0.739	0.785	0.77	0.604	LT 0.427
	CADMIUM	0.847	LT 1.2	1.81*	LT 1.2	LT 1.2	LT 1.2	21.6*	12.8*	LT 1.2	LT 1.2	LT 1.2	LT 1.2
	CALCIUM	114483	18300	35100	24800	16300	14100	45100	38000	30000	20100	38700	37500
	CHROMIUM	20.62	16.9	16.5	13.4	11.2	7.92	16.5	15.5	16.1	14.6	13	7.58
	COBALT	6.94	6.38	6.78	5.35	4.75	3.52	8.68*	7.22*	5.98	6.25	5.42	3.37
	COPPER	24.72	9	8.21	5.34	4.91	10.2	13	11	11.4	8.66	8.53	5.61
	IRON	22731	16200	15900	12500	10900	8390	16100	15700	16000	14800	13500	8550
	LEAD	18.23	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44
	MAGNESIUM	7061	6970	6570	4900	4430	3210	6730	6640	6220	5730	6240	4220
	MANGANESE	698.3	390	364	296	249	189	508	430	359	362	286	145
	NICKEL	17.4	11.3	12.3	10.3	7.53	6.32	16.8	13.8	12.2	11.7	10.7	5.55
	POTASSIUM	5449	3870	4600	2730	2240	1730	4290	4180	3690	3070	3440	1990
	SODIUM	337	1900*	287	293	493*	252	262	308	385*	394*	1790*	918*
	VANADIUM	28.39	25.2	24.7	23	17	13#	25.5	24.9	25	22.1	20.7	13.6
	ZINC	102.8	46.4	356*	47	35.1	231*	6300*	5300*	186*	47.4	30	21.2
SEMIVOLATILES	BENZYL ALCOHOL	N/A	0.079*	0.067*	0.062*	0.051*	0.065*	0.047*	0.052*	LT 0.032	LT 0.032	LT 0.032	LT 0.032
	DI-N-BUTYL PHTHALATE	N/A	LT 1.3	LT 1.3	LT 1.3	LT 1.3	LT 1.3	LT 1.3	LT 1.3	LT 1.3	LT 1.3	2.2#	3#
	HEXACHLOROBENZENE	N/A	LT 0.08	LT 0.08	LT 0.08	LT 0.08	LT 0.08	LT 0.08	LT 0.08	LT 0.08	LT 0.08	LT 0.08	LT 0.08

Table 5-45. Summary of Analytes Detected in Soil for the Chemical Range (SWMU 07) - Phase II (continued)

Bullet Stop (Subsurface Soil)

Group	Analytes	Background Concentrations	CRP-94-13B (5ft)	CRP-94-13C (10ft)	CRP-94-14B (5ft)	CRP-94-14C (10ft)
	ARSENIC	11.69	3.96	3.5	6.2	17.6*
METALS	CADMIUM	0.847	LT 1.2	1.56*	LT 1.2	LT 1.2
	CALCIUM	114483	13500	4200	20900	8420
	CHROMIUM	20.62	4.77	3.76	2.57	1.66
	COPPER	24.72	3.99	7	LT 2.84	LT 2.84
	IRON	22731	6850	796#	5570#	2170#
	MAGNESIUM	7061	1670	362#	2010	1200
	NICKEL	17.4	4.19	3.83	3.67	LT 2.74
	SODIUM	337	102	64.6	74.6	302
	ZINC	102.8	13.7	9900*	15.6	24.3

Northwest Test Area Trench (Subsurface Soil)

		Background Concentrations	CRP-94-06B (5ft)	CRP-94-06C (10ft)	CRP-94-07B (5ft)	CRP-94-07C (10ft)	CRP-94-08B (5ft)	CRP-94-08C (10ft)	CRP-94-09B (5ft)	CRP-94-09B(D) (5ft)	CRP-94-09C (10ft)	CRP-94-09C(D) (10ft)	CRP-94-10B (5ft)
METALS	ALUMINUM	28083	40100*	6110	42400*	11200	40100*	3280#	36900*	35100*	29400*	31000*	13800
	ARSENIC	11.69	11.3	5.11	11.6	LT 2.5	9.82	3.78	9.39	9.16	8.62	8.55	9.44
	BARIUM	247.1	245	60	265*	78.4	239	37.2#	211	236	215	198	80.8
	BERYLLIUM	1.455	1.79*	0.604	1.77*	0.541	1.64*	0.765	1.55*	1.41	1.27	1.38	0.637
	CALCIUM	114483	34300	85000	38300	4000	40300	140000*	45000	31500	31800	27000	18600
	CHROMIUM	20.62	38.3*	7.5	37.9*	12.9	36.2*	3.5	33.2*	32.3*	29.9*	29.5*	13.5
	COBALT	6.94	9.72*	4.21	11.1*	5.44	10.3*	5.13	10*	9.19*	8.92*	9.6*	5.87
	COPPER	24.72	22.4	3.6	24.2	7.87	23.2	11.9	22.7	21.2	19.7	21.7	9.11
	IRON	22731	35900*	7000	36500*	13100	34600*	3670#	32900*	30400*	29400*	31500*	14200
	LEAD	18.23	19.7*	10.9	21.9*	10.7	19.1*	LT 7.44	18.4*	11.7	13.8	15.5	9.51
	MAGNESIUM	7061	12700*	4970	13700*	3250	13300*	1920	14000*	13300*	10400*	11300*	5150
	MANGANESE	698.3	513	63.8#	545	250	531	31.7#	530	526	490	557	215
	MERCURY	0.0572	LT 0.05	0.119*	LT 0.05	0.0595*	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	27*	5.08	26.8*	11.7	25.2*	13.6	24*	21.8*	23.4*	22.6*	11.3
	POTASSIUM	5449	9440*	1080#	10600*	1880	10500*	558#	10200*	9640*	6020*	6790*	3310
	SODIUM	337	6140*	1950*	6800*	2750*	6840*	1420*	5600*	5250*	5230*	5760*	2440*
	THALLIUM	11.7	LT 34.3	LT 34.3	LT 34.3	LT 34.3	55.3*	LT 34.3	45.7*	LT 34.3	50.1*	LT 34.3	LT 34.3
	VANADIUM	28.39	49.4*	11.9#	48.5*	16.2	47.8*	3.45#	43.4*	42.3*	36.7*	38.2*	18.5
	ZINC	102.8	85.1	15.2	89.3	36.9	84.1	8.84	83	77.8	73.8	85	31.8
SEMIVOLATILES	BENZYL ALCOHOL	N/A	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032	0.049*	LT 0.032	0.061*	0.056*	LT 0.032

Table 5-45. *Summary of Analytes Detected in Soil for the Chemical Range (SWMU 07) - Phase II (continued)*

Northwest Test Area Trench (Subsurface Soil)

Group	Analytes	Background Concentrations	CRP-94-10C (10ft)	CRP-94-11B (5ft)	CRP-94-11C (9ft)	CRP-94-12B (5ft)	CRP-94-12C (10ft)
METALS	ALUMINUM	28083	11200	3700#	1690#	940#	1440#
	ARSENIC	11.69	3.74	LT 2.5	LT 2.5	LT 2.5	LT 2.5
	BARIUM	247.1	112	34.3#	14.9#	11.7#	12.9#
	BERYLLIUM	1.456	1.03	LT 0.427	LT 0.427	LT 0.427	LT 0.427
	CALCIUM	114483	77000	65000	20800	38000	41600
	CHROMIUM	20.62	11.5	3.72	2.91	2.52	3.67
	COBALT	6.94	3.81	3.66	LT 2.5	LT 2.5	LT 2.5
	COPPER	24.72	9.06	12.9	4.66	LT 2.84	3.4
	IRON	22731	11400	5450#	4200#	2870#	4580#
	LEAD	18.23	13.4	9.24	LT 7.44	LT 7.44	LT 7.44
	MAGNESIUM	7061	4290	1990	2150	1440	2380
	MANGANESE	698.3	173	158	46.9#	32.2#	55.8#
	MERCURY	0.0572	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	7.72	4.61	3.5	LT 2.74	3.84
	POTASSIUM	5449	2400	1040#	296#	229#	352#
	SODIUM	337	2590*	69.1	78.4	49.6	88.1
	THALLIUM	11.7	LT 34.3	48.7*	LT 34.3	37.4*	45.7*
	VANADIUM	28.39	12#	5.13#	4.98#	3.83#	5.44#
	ZINC	102.8	38.3	33.5	12.4	31.7	14.6
SEMIVOLATILES	BENZYL ALCOHOL	N/A	0.054*	LT 0.032	0.041*	LT 0.032	LT 0.032

Note.- All values in μg/g (equal to ppm).

LT = Analyte concentration is less than the CRL, the CRL is posted next to the "LT".

= Analyte was detected in the associated blank in excess of the 5 or 10 times rule (as described in Section 3.1.1.1).

* = Organic analyte detected above CRL or MDL or detected inorganic analyte exceeding background.

N/A = Not Applicable.

(D) = Duplicate analysis.

at concentrations above background. Zinc was detected at 800 $\mu g/g$ at a depth of 5 feet and 110 $\mu g/g$ at 7.5 feet. Lead was detected at a concentration of 31 $\mu g/g$ at a depth of 5 feet.

Test Pit 2 at SWMU 7 was excavated in an area identified during the geophysical survey northwest of the building foundation that appeared to correspond to the western portion of one of the former disposal trenches at the site. The surface sample collected at the test pit location contained no contaminants above background levels. Two SVOCs, bis(2-ethylhexyl) phthalate and butylbenzyl phthalate, were detected at low concentrations (0.339 and 0.665 $\mu g/g$, respectively) in the sample taken at a depth of 5 feet. It appears that the test pit was located just west of the target trench. No debris was encountered in this test pit.

Test Pit 3 was located just west of the building foundation. This area was identified by both geophysical surveys as an area of potential buried debris. Butylbenzyl phthalate was detected in the surface soil sample (CRS-92-301) at 0.292 $\mu g/g$. Only one metal, iron, was detected above the background threshold value; it was detected at a depth of 5 feet in a concentration of 24,000 $\mu g/g$. No debris was encountered in the test pit, and the source of the geophysical anomaly remains unknown.

In summary, although open trenches were filled with a variety of debris at this site, the results of the test-pit sampling from one of these trenches indicate that the subsurface soils do not contain extensive contamination. The location of the second trench was not readily discernable on the basis of the geophysical survey. It is not certain why the trench failed to show as a distinct anomaly given the fact that both trenches reportedly contained metal debris.

During Phase II, five test pits, CRP-94-01 through -05, were excavated in areas of geophysical anomalies at the Firing Point and a sixth pit, CRP-94-15, was excavated just west of these anomalies (see Figure 5-7). The geophysical anomalies were identified by a DANS survey completed during the Phase II RI. The former trenches were identified by the geophysical survey because of the abundance of buried metal debris. Metal debris was encountered in each test pit between 1 foot and 6.5 feet bgs. In most cases, the subsurface soil samples were collected directly below the debris to determine the vertical extent of metals, explosives, and SVOC contamination. No explosive contamination was detected for any of the samples collected from the Firing Point.

The SVOC benzyl alcohol was detected in trace amounts in CRP-94-02 through CRP-94-05, ranging from 0.043 to 0.079 $\mu g/g$. Di-N-butyl phthalate was detected in sample CRP-94-02A at 2.6 $\mu g/g$ and hexachlorobenzene was detected at 0.34 $\mu g/g$. Unknown SVOCs were also reported from the samples collected in the vicinity of the Firing Point as shown in Appendix P. Test pit number CRP-94-01, located over the southeast geophysical anomaly (see Figure 5-7), encountered a trench filled with metal debris from 2 to 4 feet bgs. The southern edge of this trench clearly defined the southern extent of the debris buried at the Firing Point. This debris layer included approximately 90 empty, rusted, 3.5-inch training heat rocket components; miscellaneous burned metal debris; fuses; and smoke flares. In the soil sample collected at a depth of 5 feet (CRP-94-01A), 1 foot below the bottom of the debris layer, cobalt, magnesium, and vanadium were detected at levels just slightly above the background sample concentrations. At a depth of 7 feet, zinc was detected at 218 $\mu g/g$, two times the

calculated background concentration of 103 μg/g (CRP-94-01B) (Figure 5-7). A distinct lithology change from primarily a silt with minor sand and gravel lenses to a poorly graded sand with gravel and minor silt occurred just above 9 feet (Appendix B). Elevated concentrations of cadmium (2.63 μg/g), copper (28.8 μg/g), lead (48.5 μg/g), and zinc (1,040 μg/g) were all detected at a depth of 9 feet (CRP-94-01C), and elevated levels of copper (32.1 μg/g) and zinc (697 μg/g) were still detected above background concentrations at 10 feet (CRP-94-01D).

Test pit number CRP-94-02 is the northernmost test pit at the firing point (see Figure 5-7). Wood and metal debris were observed in this test pit from about 4 to 6.5 feet. The test pit was excavated along the northern boundary of the corresponding geophysical anomaly to define the horizontal extent of the buried debris. The first sample was collected at a depth of 5 feet directly in the debris pile. This sample contained concentrations of arsenic (17.5 μg/g), cadmium (9.48 μg/g), cobalt (7.52 μg/g), copper (99.6 μg/g), lead (19.6 μg/g), iron (25,100 μg/g), and zinc (12,000 μg/g) above the background metals concentrations (Table 5-45). Sodium was the only inorganic analyte detected above background at 7 feet, approximately 0.5 foot below the buried debris. Zinc, at 178 μg/g, and sodium, at 502 μg/g, were detected at 9 feet bgs above the background threshold values of 103 and 337 μg/g, respectively. A change in lithology from silt to silt with gravel occurs at 9 to 9.5 feet (Appendix B). At 10 feet, several metals—cobalt (8.56 μg/g), chromium (20.7 μg/g), copper (42.5 μg/g), vanadium (29.6 μg/g), zinc (2,500 μg/g), magnesium (7,390 μg/g), and iron (24,200 μg/g)—were detected at elevated concentrations.

Test pit number CRP-94-03 is the westernmost test pit at the Firing Point. Three observation pits were explored before this test pit was excavated and sampled (see Figure 5-7). Due to the lack of debris found in any of the observation pits, it was possible to define the western boundary of the disturbed soil corresponding to the former open trenches. Also, the southern end of test pit CRP-94-03 outlined the southern edge of disturbed soil. Metal debris, including barrel rings and tops, M9 smoke grenades, smoke incendiary devices, and ammunition boxes, was encountered from about 2 to 3.5 feet bgs while digging this test pit. Cobalt at 7.26 μg/g, magnesium at 7,210 μg/g, and sodium at 1,030 μg/g were the only metals detected above background in the 5-foot sample (Table 5-45). Sodium was the only metal detected above background in any of the samples below 5 feet. Concentrations were at 2,070, 996, and 1,900 μg/g at 7, 9, and 10 feet, respectively.

Test pit number CRP-94-04, located near Test Pit 1 from the Phase I RI field activities (see Figure 5-7), encountered a buried trench filled with metal debris at depths ranging from 1 foot to 5 feet bgs (Appendix B). Cadmium (1.81 μg/g) and zinc (356 μg/g) were found in concentrations exceeding background metals concentrations in the 5-foot sample (Table 5-45). The 7-foot sample did not contain any elevated metals concentrations. The 9-foot sample had a sodium concentration of 385 μg/g, just slightly above background. The soil type changed from a silt to a poorly graded sand with gravel (Appendix B). The 10-foot sample did have a zinc concentration of 231 μg/g that exceeded the background level of 103 μg/g.

Test pit number CRP-94-05, located in the middle of the geophysical anomalies (see Figure 5-7), encountered metal debris from a depth of 2 to 3 feet (Appendix B). Samples were

collected at depths of 4, 5, 7, and 10 feet. Cadmium (21.6 μg/g), cobalt (8.68 μg/g), and zinc (6,300 μg/g) were all detected in the 4-foot sample (see Table 5-45). In the 5-foot sample, the concentrations of these metals decreased slightly but were still greater than the background metals concentrations. At 7 feet, zinc and sodium are the only metals with concentrations greater than background at 186 μg/g and 385 μg/g, respectively. The number of analytes and their concentrations generally decreased with depth; only sodium, at a concentration of 394 μg/g, exceeded the background concentrations in the 10-foot sample. Vertical migration of metals appears to be limited to 7 feet at this location.

Test pit number CRP-94-15 was excavated adjacent to the concrete pad near the Firing Point. This test pit was excavated near the Phase I, Test Pit 3 location where the potentially buried trench from the Weston geophysical investigation was identified. Sodium was the only analyte detected above background in any of the samples (see Table 5-45).

Two surface soil samples, CRS-94-17 and -18, were also collected at the Firing Point. These samples were collected outside of what was thought to be the area disturbed by trenching activities. CRS-94-17 was located west of the former trenches, just north of observation pit 1 where no debris was buried; CRS-94-18 was collected north of CRP-94-02 where the northern boundary of the trenching activities was defined. Inorganic contamination was detected in both of these surface samples. Chromium (22.7 μg/g), lead (31.2 μg/g), magnesium (7,780 μg/g), potassium (5,670 μg/g), and sodium (358 μg/g) were detected above the background levels in surface sample CRS-94-17; and cobalt (6.95 μg/g), chromium (25.4 μg/g), vanadium (29.7 μg/g), magnesium (8,780 μg/g), and potassium (6,450 μg/g) were found at elevated levels in CRS-94-18.

In summary, all of the Phase II test pits at the Firing Point encountered debris at varying depths with the exception of CRP-94-15 adjacent to the concrete pad. The vertical extent of metals contaminant migration was defined in test pits CRP-94-03 and -05 as not exceeding 5 feet and 10 feet, respectively. Metals concentrations exceeded background in the deepest samples collected in the remaining three test pits (CRP-94-01, -02, and -04). Also, the areal extent of contamination was not outlined. The two surface soil samples and the five surface soil samples associated with the test pits all contained elevated metals. This widespread surface contamination may be the result of burning activities that occurred in the adjacent trenches.

5.2.3.3.2 ***Northwest Test Area Trench.*** No Phase I investigation was conducted in the Northwest Test Area. Seven test pits, CRP-94-06 through -12, and one observation pit were excavated during Phase II in this area to characterize the newly located open trench (CRP-94-11 and -12) and to determine the source of the large-scale geophysical anomaly delineated during the 1994 DANS survey (CRP-94-06 through -10) (see Figure 5-8). The soil samples for all seven test pits in this area were collected at depths of 0.5, 5, and 10 feet and analyzed for metals, explosives, and SVOCs. Three surface soil samples were also collected in this area. No explosives were detected in any of the soil samples collected in the Northwest Test Trench Area. The SVOC benzyl alcohol was detected in trace amounts in samples from CRP-94-9 through CRP-94-11. Benzyl alcohol concentrations ranged from 0.041 to 0.061 μg/g. Unknown SVOCs were also reported from the samples collected at the northwest trench

area as presented in Appendix P.

The two test pits excavated in each end of the open trench, CRP-94-11 and -12, were dug beneath the large pile of debris disposed of in the open trench. The open trench is about 16 feet wide, 46 feet long, and 6 feet deep. The soil that had been removed during excavation of the trench is piled at the northern end. The debris buried in and present on the surface of the trench includes ammunition cans, 40-mm expended CS grenades (tear gas), wood debris mainly from shipping boxes, barrel rings, smoke grenades, 75-mm aluminum casings, 40-mm base charges, thermite shipping containers, and other metal debris. There are also some indications that burning was performed in the open trench. Elevated concentrations of cadmium (4.94 μg/g), mercury (0.09 μg/g), zinc (811 μg/g), and thallium (37.3 μg/g) were detected above their corresponding background concentrations in sample CRP-94-12A, which was collected from the floor of the trench just below the pile of debris (see Table 5-45). Thallium was also detected above background concentrations in the 5- and 10-foot samples from CRP-94-12 as well as the 5-foot sample from CRP-94-11. Concentrations ranged from 37.4 to 48.7 μg/g.

Three surface soil samples, CRS-94-01, -02, and -03, were also collected approximately 20 feet west, south, and east of the open trench, respectively (see Figure 5-8). No contaminants were detected above background concentrations in CRS-94-01. Cobalt (8.54 μg/g), chromium (25.1 μg/g), lead (19.7 μg/g), vanadium (31.2 μg/g), magnesium (6,980 μg/g), potassium (3,860 μg/g), and sodium (514 μg/g) were detected above background concentrations on the south side of the trench (CRS-94-02), and lead and sodium were detected above background on the east side of the trench (CRS-94-03) at 30.4 and 514 μg/g, respectively.

South of the open trench, five test pits and one observation pit were excavated within the large geophysical anomaly that extends from the northwest corner of the geophysical grid at least 1,300 feet to the southeast. No buried debris was encountered in any of these test pits. The surface of the area is relatively flat and looks as if it might have been graded. The lithology of the anomaly area, as described from the test pits, consists primarily of silt with abundant clay and interbedded lenses of clay overlying a well-graded sand and gravel (Appendix B).

The surface sample from test pit number CRP-94-06 contained chromium (23.2 μg/g), lead (22.5 μg/g), iron (23,200 μg/g), magnesium (14,600 μ/g), potassium (9,250 μg/g), and sodium (657 μg/g) concentrations above background. There were 11 inorganics—beryllium (1.79 μg/g), cobalt (9.72 μg/g), chromium (38.3 μg/g), lead (19.7 μg/g), nickel (27 μg/g), vanadium (49.4 μg/g), aluminum (40,100 μg/g), iron (35,900 μg/g), magnesium (12,700 μg/g), potassium (9,440 μg/g), and sodium (6,140 μg/g)—that exceeded background concentrations in the 5-foot sample at this location. A distinct color change was noted in the soil at 8 feet from a dark to a light yellowish brown that was not caused by a change in moisture content of the soil. At 10 feet, the only metals that exceeded the background levels were mercury at 0.119 μg/g and sodium at 1,950 μg/g.

Test pit number CRP-94-07 (see Figure 5-8) had above-background concentrations of metals at all three sample depths. The surface sample contained barium (289 μg/g), cobalt (8.22 μg/g), chromium (23.3 μg/g), nickel (18.3 μg/g), lead (20.2 μg/g), thallium (35.8 μg/g), iron

(25,600 μg/g), magnesium (16,300 μg/g), potassium (10,700 μg/g), and sodium (731 μg/g) (see Table 5-45). At 5 feet, several metals were detected above background concentrations including barium (265 μg/g), beryllium (1.77 μg/g), cobalt (11.1 μg/g), chromium (37.9 μg/g), nickel (26.8 μg/g), lead (21.9 μg/g), vanadium (48.5 μg/g), aluminum (42,400 μg/g), iron (36,500 μg/g), magnesium (13,700 μg/g), potassium (10,600 μg/g), and sodium (6,800 μg/g). Distinct clay lenses were interbedded with the silt at this depth. The color change from dark to light brown found in CRP-94-06 is also visible between the 5-foot and 10-foot samples in this test pit. As with test pit CRP-94-06, the metals exceeding the background metals levels in this test pit dropped to just mercury at 0.0595 μg/g and sodium at 2,750 μg/g at a depth of 10 feet.

Metal debris was scattered on the ground surface of test pit number CRP-94-08. This surface debris may be the source of the elevated metals concentrations detected in the surface sample: barium (412 μg/g), beryllium (1.71 μg/g), cobalt (11.2 μg/g), chromium (34.3 μg/g), copper (26.6 μg/g), manganese (732 μg/g), lead (25.5 μg/g), nickel (24.2 μg/g), vanadium (39.9 μg/g), aluminum (39,800 μg/g), iron (35,000 μg/g), magnesium (21,300 μg/g), potassium (15,700 μg/g), and sodium (961 μg/g). Metals detected above background in the 5-foot sample were beryllium (1.64 μg/g), cobalt (10.3 μg/g), chromium (36.2 μg/g), lead (19.1 μg/g), thallium (55.3 μg/g), nickel (25.2 μg/g), vanadium (47.8 μg/g), aluminum (40,100 μg/g), iron (34,600 μg/g), magnesium (13,300 μg/g), potassium (10,500 μg/g), and sodium (6,840 μg/g). Soil in this test pit was characterized as silt with a moderate amount of clay down to a depth of 9 feet. At 9 feet there is a distinct color change in the soil from dark yellowish brown to light yellowish brown. Only calcium and sodium exceeded the background concentration at 10 feet.

Test pit number CRP-94-09 has the greatest number of metals exceeding background levels in this group of test pits from the surface to the 10-foot sample (see Figure 5-8). Barium (257 μg/g-dup), beryllium(1.11 μg/g-dup), cobalt (8.49 μg/g-dup), chromium (22.8 μg/g-dup), copper (26.4 μg/g), lead (36.3 μg/g), thallium (38.2 μg/g), iron (24,800 μg/g-dup), magnesium (16,000 μg/g-dup), potassium (10,900 μg/g-dup), and sodium (912 μg/g-dup) were all detected at the surface. Several metals were also detected in the 5-foot sample at concentrations above the background level. At the 10-foot interval, metals exceeding background consist of cobalt (9.6 μg/g-dup), chromium (29.9 μg/g), nickel (23.4 μg/g), thallium (50.1 μg/g), vanadium (38.2 μg/g-dup), aluminum (31,000 μg/g-dup), iron (31,500 μg/g-dup), magnesium (11,300 μg/g-dup), potassium (6,790 μg/g-dup), and sodium (5,760 μg/g-dup).

The last test pit in the geophysical anomaly is number CRP-94-10 (see Figure 5-8). Cobalt (7.6 μg/g), chromium (22.4 μg/g), lead (21 μg/g), iron (24,300 μg/g), magnesium (15,500 μg/g), and potassium (11,100 μg/g) were detected in concentrations exceeding background at the surface sample only. The subsurface soil was classified as a silt, but it had a unique brown color that was distinct from all of the other soils in this location. Sodium was detected in both surface (1,240 μg/g) and subsurface (2,590 μg/g at 10-foot) samples above the background threshold value.

In summary, the identified open trench area and the area of the large-scale, geophysical

anomaly appear to contain elevated concentrations of a variety of metals. On the basis of the subsurface data from the open trench, it appears that significant vertical migration of the metal contaminants has not yet occurred. However, the areal extent of the surface contamination at this site has not been defined. The subsurface data from the area of the geophysical anomaly to the south indicate that elevated concentrations of metals exist below the surface. The source of this large-scale geophysical anomaly is still uncertain because no buried trenches or manmade debris was encountered. It is possible that this anomaly represents a natural lithologic feature such as finer sediment deposited in an existing drainage. The observation pit, excavated along the boundary of this anomaly, uncovered a dipping bed of well-graded sand and gravel underlying a silt and clay deposit. A difference in density, water content, or sodium content between the two lithologies could have created this geophysical anomaly. It is possible that either the change in lithology or mineral content of the soil or adsorption of cations to the smaller clay particles is causing the elevated metals concentrations in the soils containing higher percentages of clay-sized particles.

5.2.3.3.3 ***Bullet Stop and Firing Course.*** In addition to the samples collected at the Firing Point and the Northwest Test Area Trench, three test pits were excavated along the firing line (CRP-94-13 through CRP-94-15) during Phase II. CRP-94-15 was previously discussed in Section 5.2.3.1. Thirteen surface soil samples were also collected over the firing course (see Figure 5-9). The test pit soil samples were collected at depths of 0.5, 5, and 10 feet and analyzed for metals, explosives, and SVOCs. The surface samples were analyzed for the same analyte suite. No explosives or SVOCs were detected in any of the soil samples collected in this area. Unknown SVOCs were reported from the samples that were collected at the Bullet Stop and Firing Course as presented in Appendix P.

The first test pit, CRP-94-13, was excavated near the bullet stop. The area just east of the Bullet Stop was surveyed for geophysical anomalies during this Phase II field investigation, but no anomalies were detected. In the surface sample, thallium was detected just above the background metal concentration (at 40.2 μg/g) (see Table 5-45). Magnesium (9,740 μg/g) and potassium (5,700 μg/g) were also detected above background in this sample. No metals above background concentrations were detected at 5 feet. At 6 feet, a distinct lithology change was noted from silt to a poorly graded, fine sand. In the 10-foot sample, cadmium (1.56 μg/g) and zinc (9,900 μg/g) were found in concentrations exceeding their corresponding background threshold concentrations.

Eight surface soil samples were collected surrounding the Bullet Stop and test pit CRP-94-13. Samples CRS-94-04 through -11 were collected to characterize the horizontal extent of contamination from the testing activities around the Bullet Stop. CRS-94-04, located behind the Bullet Stop to the north, contained levels of cobalt (8.12 μg/g), chromium (24.6 μg/g), copper (26.3 μg/g), lead (29.8 μg/g), vanadium (32.3 μg/g), magnesium (9,140 μg/g), sodium (574 μg/g), and potassium (6,450 μg/g) above the background concentrations. Located directly behind the Bullet Stop at sample location CRS-94-05, concentrations of cobalt (7.02 μg/g), chromium (24.1 μg/g), lead (19.3 μg/g), vanadium (30.4 μg/g), magnesium (10,900 μg/g), sodium (528 μg/g), and potassium (6,920 μg/g) exceeded the background levels. Lead (24.4 μg/g), magnesium (9,130 μg/g), sodium (518 μg/g), and potassium (5,860

μg/g) were detected in CRS-94-06 located southwest of the Bullet Stop. Two surface soil samples were collected from the east face of the Bullet Stop, CRS-94-07 and -08; both of these two surface soil samples and CRS-94-09, located just east of the Bullet Stop, contained elevated concentrations of lead (136 μg/g and 298 μg/g, and 164 μg/g, respectively). The highest value was detected in sample CRS-94-08 at 298 μg/g compared to the background concentration of 18.2 μg/g. Samples CRS-94-10 and -11, located on the north and south boundaries of the firing range near the Bullet Stop (see Figure 5-9), also contained lead just above the background concentration (19.2 μg/g and 21.6 μg/g, respectively). Magnesium and sodium were also detected above background and in one or more of these samples.

Test pit number CRP-94-14 was located midway down the firing line. Only arsenic was detected in this test pit above the background concentration (17.6 μg/g at 10 feet). Five surface soil samples, CRS-94-12 through-16, were also located in this center region of the firing range close to CRP-94-14. CRS-94-12, sampled on the southern boundary of the firing range west of test pit CRP-94-14, contained lead (24.8 μg/g), magnesium (7,880 μg/g), and sodium (433 μg/g) at concentrations above background; while CRS-94-16, located just south of CRP-94-14, had detections of cobalt (7.6 μg/g), chromium (23.7 μg/g), magnesium (11,700 μg/g), sodium (614 μg/g), and potassium (6,960 μg/g) above background levels. CRS-94-13, which is directly west of test pit CRP-94-14 in the firing line, had chromium (26 μg/g), vanadium (30.2 μg/g), magnesium (9,680 μg/g), potassium (6,440 μg/g), and sodium (372 μg/g) concentrations detected above background. Elevated metals concentrations were also detected in CRS-94-14 and -15, which are on the northern boundary of the firing range (see Figure 5-9). Chromium (22.9 μg/g), magnesium (9,580 μg/g), sodium (427 μg/g), and potassium (5,530 μg/g) were detected above the background concentration in CRS-94-14; chromium (25.4 μg/g), lead (24.4 μg/g), vanadium (30.1 μg/g), magnesium (11,200 μg/g), sodium (573 μg/g), and potassium (6,600 μg/g) were detected in surface sample CRS-94-15. On the basis of the two test pits CRP-94-13 and -14 and surface soil samples CRP-94-4 through CRP-94-11, it appears that there are metals detected above background concentrations over the firing range that may be related to the munitions-testing activities that previously occurred at SWMU 7. These above background metals concentrations in the surface soils extend beyond the bullet stop. However, the primary area of concern is the Bullet Stop itself and the area directly in front of the Bullet Stop where the lead concentrations are present at concentrations that are several times the background levels. The soil samples with elevated lead levels are limited to surface samples. Test pit CRP-94-13, located close to the Bullet Stop, did not contain elevated levels of lead on the surface or at depth.

5.2.4 Human Health Risk Assessment

As part of the Phase II RI, an RA was conducted to estimate potential human health risks associated with the no-action alternative for SWMU 7, the Chemical Range. The following tasks were completed in the RA:

- Data analysis and selection of COPCs
- Exposure assessment
- Toxicity assessment

- Risk characterization
- Conclusions and recommendations

This section provides a summary of the quantitative process employed at SWMU 7 and the results of that process. The RA for SWMU 7 is based on the methodology described in Section 3.1 and supported by Appendices L, M, N, and O.

5.2.4.1 *Selection of the Chemicals of Potential Concern—Soil*

As detailed in USEPA guidance (USEPA 1989a; USEPA 1994), a screening procedure can be used to narrow the list of contaminants at a particular site to a subset of analytes that can be considered the COPCs for the area. This screenng procedure can involve up to four steps, depending on the contaminants present:

- Group data by chemical class (e.g., carcinogenic PAHs)
- Evaluate frequency of detection
- Evaluate essential nutrients
- Compare site data to risk-based screening concentrations (Region III values)

Below is the screening analysis for SWMU 7. For the purposes of this risk assessment, each area of concern was evaluated separately.

5.2.4.1.1 *Firing Point*

Data Grouping. No data grouping was necessary as part of COPC selection at the Firing Point.

Frequency of Detection. No evaluation of detection frequency was undertaken in surface soil at the Firing Point (maximum n = 6).

Four chemicals were detected in only 1 of 34 (3 percent) subsurface soil samples: bis(2-ethylhexyl)phthalate—0.339 μg/g, butyl benzyl phthalate—0.665 μg/g, di-n-butyl phthalate—2.6 μg/g, and hexachlorobenzene—0.34 μg/g. Since the phthalate esters are common laboratory contaminants which were detected at very low concentrations, they were eliminated from the subsurface soil database. Hexachlorobenzene, although detected at a very low concentration, was retained in the database because it can be associated with military pyrotechnic activities and, therefore, could be expected to be present at the site.

Nutrient Screening. All of the nutrients detected above background in surface soil had maximum detected values that were less than their respective nutrient screening values: magnesium (maximum—8,780 μg/g; screening value—1,000,000 μg/g), potassium (maximum—6,450 μg/g; screening value—150,000 μg/g), and sodium (maximum—3,850 μg/g; screening value—1,000,000 μg/g). Therefore, these nutrients were eliminated as COPCs in surface soil.

Nutrients detected above background in subsurface soil were also below nutrient screening values: iron (maximum—25,100 μg/g; screening value—70,000 μg/g), magnesium (maximum—7,390 μg/g; screening value—1,000,000 μg/g), and sodium (maximum value 2,070 μg/g; screening value—1,000,000 μg/g). These nutrients were eliminated as COPCs from subsurface soil.

Region III RBC Screening. The final step in the COPC selection process consisted of comparing the EPCs for remaining contaminants in surface and subsurface soil with Region III RBCs. However, before these comparisons were made, a "hot spot" analysis was conducted.

Hot Spot Analysis. For the final selection of COPCs, the site was evaluated for possible "hot spots." Since the samples collected at the Firing Point were collected from an area approximately the size of a hypothetical 0.5-acre residential lot, all samples were combined for the calculation of the EPCs. Table 5-46 provides a summary of the EPCs for preliminary COPCs in surface and subsurface soil at the Firing Point.

Soil-related Exposure Pathways. To select COPCs for the soil-related exposure pathways, the EPCs for the Firing Point in surface and subsurface soil were compared to Region III soil ingestion and soil-to-air RBCs. As shown in Table 5-47, no chemicals were retained as COPCs for soil-related pathways in surface soil at the Firing Point area. The only chemical retained as a COPC in subsurface soil was arsenic.

5.2.4.1.2 *Northwest Test Area Trench*

Data Grouping. No data grouping was necessary as part of COPC selection at the Northwest Test Area Trench.

Frequency of Detection. No evaluation of detection frequency was undertaken in surface soil or subsurface soil at the Northwest Test Area Trench (maximum n = 14).

Nutrient Screening. All four of the nutrients detected above background in surface soil (see Table 5-45) had maximum detected values that were less than their respective nutrient screening values: iron (maximum—35,000 μg/g; screening value 70,000 μg/g), magnesium (maximum—21,300 μg/g; screening value—1,000,000 μg/g), potassium (maximum—15,700 μg/g; screening value—150,000 μg/g), and sodium (maximum—1,240 μg/g; screening value—1,000,000 μg/g). Therefore, these nutrients were eliminated as COPCs in surface soil.

Nutrients detected above background in subsurface soil were also below nutrient screening values: calcium (maximum—140,000 μg/g; screening value 1,000,000 μg/g); iron (maximum—36,500 μg/g; screening value—70,000 μg/g), magnesium (maximum—14,000 μg/g; screening value—1,000,000 μg/g), potassium (maximum 10,600 μg/g; screening value—150,000 μg/g), and sodium (maximum—6,840 μg/g; screening value—1,000,000 μg/g). These nutrients were eliminated as COPCs from subsurface soil.

Table 5-46. Summary of Preliminary Chemicals of Potential Concern (SWMU 7)

Chemical	Frequency of Detection[a]	Range of Detected Values (µg/g)	Range of Reporting Limits (µg/g)	Arithmetic Mean Concentration (µg/g)	95% UCL Concentration (µg/g)	Exposure Point Concentration[b] (µg/g)
Firing Point Area - Surface Soil						
Chromium	6/6	13.9 - 25.4	NA	18.3	23.6	23.6
Cobalt	3/3	3.51 - 6.95	NA	5.8	25.0	6.95
Lead	5/6	7.0 - 31.2	7.44	12.0	33.9	31.2
Vanadium	3/3	21.5 - 29.7	NA	25.9	38.2	29.7
Butyl benzyl phthalate	1/3[c]	0.292	0.33	0.206	0.711	0.292
Firing Point Area - Subsurface Soil						
Arsenic	22/32[d]	3.58 - 17.5	24.0 - 240	11.6	16.7	16.7
Cadmium	5/34	1.81 - 21.6	0.42 - 1.20	1.15	2.05	2.05
Chromium	33/34	5.41 - 20.7	3.90	13.7	14.9	14.9
Cobalt	22/22	3.06 - 8.68	NA	6.13	6.89	6.89
Copper	34/34	2.44 - 99.6	NA	11.9	15.5	15.5
Lead	15/34	4.80 - 48.5	7.44	7.9	10.3	10.3
Vanadium	20/22	13.6 - 29.9	2.81	24.3	38.7	29.9
Zinc	34/34	10.9 - 12,000	NA	532	1,739	1,739
Benzyl alcohol	10/25[e]	0.043 - 0.079	0.03 - 0.33	0.050	0.077	0.077
Hexachlorobenzene	1/34	0.340	0.08 - 0.26	0.078	0.100	0.100
Northwest Test Area Trench - Surface Soil						
Aluminum	8/10	12,600 - 39,800	819	19,102	26,263	26,263
Barium	8/10	107 - 412	8.76	184	258	258
Beryllium	7/10	0.631 - 1.71	0.43	0.857	1.16	1.16
Cadmium	1/10	4.94	1.20	0.90	1.62	1.62
Chromium	10/10	1.28 - 34.3	NA	18.7	24.4	24.4
Cobalt	9/10	2.66 - 11.2	2.50	6.52	8.23	8.23
Copper	10/10	4.03 - 26.6	NA	18.8	22.9	22.9
Lead	9/10	10.8 - 36.3	7.44	20.7	26.0	26.0
Manganese	8/10	318 - 732	25.9	449	601	601
Mercury	2/10	0.053 - 0.090	0.05	0.034	0.047	0.047
Nickel	10/10	4.53 - 24.2	NA	13.8	21.7	21.7
Thallium	3/10	35.8 - 38.2	34.3	23.0	30.0	30.0
Vanadium	8/10	19.0 - 39.9	2.41	22.1	29.3	29.3
Zinc	10/10	11.1 - 811	NA	116	396	396

Table 5-46. Summary of Preliminary Chemicals of Potential Concern (SWMU 7) (continued)

Chemical	Frequency of Detection[a]	Range of Detected Values (μg/g)	Range of Reporting Limits (μg/g)	Arithmetic Mean Concentration (μg/g)	95% UCL Concentration (μg/g)	Exposure Point Concentration[b] (μg/g)
Northwest Test Area Trench - Subsurface Soil						
Aluminum	9/14	6,110 - 42,400	819	29,550	6.5E+05	42,400
Barium	9/14	60.0 - 265	8.76	170	2,017	265
Beryllium	10/14	0.541 - 1.79	0.43	0.931	1.80	1.79
Chromium	14/14	2.52 - 38.3	NA	17.8	44.7	38.3
Cobalt	11/14	3.66 - 11.1	2.50	5.90	7.61	7.61
Lead	10/14	9.24 - 21.9	7.44	11.7	14.7	14.7
Mercury	2/14	0.060 - 0.119	0.05	0.033	0.043	0.043
Nickel	13/14	3.50 - 27.0	2.74	14.4	31.2	27.0
Thallium	6/14	37.4 - 55.3	34.3	30.0	41.6	41.6
Vanadium	7/14	16.2 - 49.4	2.41	24.4	249	49.4
Benzyl Alcohol	4/14	0.041 - 0.061	0.03	0.026	0.036	0.036
Bullet Stop - Surface Soil						
Chromium	15/15	3.49 - 26.0	NA	19.2	22.0	22.0
Cobalt	14/15	4.32 - 8.12	2.5	5.71	6.45	6.45
Copper	14/15	14.0 - 26.3	2.84	19.1	29.7	26.3
Lead	14/15	12.2 - 298	7.44	48.3	129	129
Thallium	1/15	40.2	34.3	18.5	20.8	20.8
Vanadium	14/15	15.8 - 32.3	2.41	27.2	49.0	32.3
Bullet Stop - Subsurface Soil						
Arsenic	4/4	3.50 - 17.6	NA	7.3	79.2	17.6
Cadmium	1/4	1.56	1.20	0.826	2.34	1.56
Zinc	4/4	13.7 - 9,900	NA	1,052	2.3E+22	9,900

Note.— Range of reporting limits presents CRLs for nondetects only in order to show range of values used to calculated EPCs (1/2 the CRL). An NA means that there were no nondetects for a particular analyte.

[a]Number of samples in which the analyte was detected/total number of samples analyzed.

[b]The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (USEPA 1989).

[c]Three samples were not included in the calculations due to high CRLs.

[d]Two samples were not included in the calculations due to high CRLs.

[e]Nine samples were not included in the calculations due to high CRLs.

NA = Not applicable.

Table 5-47. Selection of Chemicals of Potential Concern for Soil-related Pathways Based on EPA Region III's RBCs (SWMU 7)

	EPA Region III RBC Screen			
	Residential RBCs ($\mu g/g$)			
Chemical	Ingestion	Inhalation	Exposure Point Conc. ($\mu g/g$)	Retained as COPC?
Firing Point - Surface Soil				
Chromium	39	140	23.6	No
Cobalt	470	NA	6.95	No
Lead	400[a]	NA	31.2	No
Vanadium	55	NA	29.7	No
Butyl benzyl phthalate	1,600	53	0.292	No
Firing Point - Subsurface Soil				
Arsenic	0.43	380	16.7	**YES**
Cadmium	3.9	920	2.05	No
Chromium	39	140	14.9	No
Cobalt	470	NA	6.89	No
Copper	310	NA	15.5	No
Lead	400[a]	NA	10.3	No
Vanadium	55	NA	29.9	No
Zinc	2,300	NA	1,739	No
Benzyl alcohol	2,300	NA	0.077	No
Hexachlorobenzene	0.4	1.0	0.100	No
Northwest Test Area Trench - Surface Soil				
Aluminum	7,800	NA	26,263	**YES**
Barium	550	35,000	258	No
Beryllium	0.15	690	1.16	**YES**
Cadmium	3.9	920	1.62	No
Chromium	39	140	24.4	No
Cobalt	470	NA	8.23	No
Copper	310	NA	22.9	No
Lead	400[a]	NA	26.0	No
Manganese	39	NA	601	**YES**
Mercury	2.3	0.7	0.047	No
Nickel	160	6,900	21.7	No
Thallium	0.55[a]	NA	30.0	**YES**
Vanadium	55	NA	29.3	No
Zinc	2,300	NA	396	No
Northwest Test Area Trench - Subsurface Soil				
Aluminum	7,800	NA	42,400	**YES**
Barium	550	35,500	265	No
Beryllium	0.15	690	1.79	**YES**
Chromium	39	140	38.3	No
Cobalt	470	NA	7.61	No
Lead	400[a]	NA	14.7	No

Table 5-47. Selection of Chemicals of Potential Concern for Soil-related Pathways Based on EPA Region III's RBCs (SWMU 7) (continued)

	EPA Region III RBC Screen			
	Residential RBCs (μg/g)			
Chemical	Ingestion	Inhalation	Exposure Point Conc. (μg/g)	Retained as COPC?
Northwest Test Area Trench - Subsurface Soil (continued)				
Mercury	2.3	0.7	0.043	No
Nickel	160	6,900	27.0	No
Thallium	0.55[(b)]	NA	41.6	YES
Vanadium	55	NA	49.4	No
Benzyl alcohol	2,300	NA	0.036	No
Bullet Stop - Surface Soil				
Chromium	39	140	22.0	No
Cobalt	470	NA	6.45	No
Copper	310	NA	26.3	No
Lead	400[(a)]	NA	129	No
Thallium	0.55[(b)]	NA	20.8	YES
Vanadium	55	NA	32.3	No
Bullet Stop - Subsurface Soil				
Arsenic	0.43	380	17.6	YES
Cadmium	3.9	920	1.56	No
Zinc	2,300	NA	9,900	YES

Note.—RBCs were taken directly from the Region III RBC Table (USEPA 1995), except as noted in the footnotes. Values for noncarcinogens are 1/10 of the Region III RBC.

[a]OSWER recommended clean-up level for lead in residential soil (USEPA 1994).

[b]Value for thallic oxide.

NA = Not applicable; value could not be calculated.

Region III RBC Screening. The final step in the COPC selection process consisted of comparing the EPCs for remaining contaminants in surface and subsurface soil with Region III RBCs. However, before these comparisons were made, a "hot spot" analysis was conducted.

Hot Spot Analysis. For the final selection of COPCs, the site was evaluated for possible "hot spots." Each sample location was evaluated separately because of the large distance between locations with respect to a hypothetical residential lot. Screening the maximum above-background chemical concentrations at each location against the Region III RBCs revealed that no single location represented a risk that was significantly greater than site-wide average risks. Therefore, all samples from the Northwest Test Area Trench were combined for the calculation of the EPCs. Table 5-46 provides a summary of the EPCs for preliminary COPCs in surface and subsurface soil at the Northwest Test Area Trench.

Soil-related Exposure Pathways. To select COPCs for the soil-related exposure pathways, the EPCs for the Northwest Test Area Trench in surface and subsurface soil were compared to Region III soil ingestion and soil-to-air RBCs. As shown in Table 5-47, four chemicals were retained as COPCs for soil-related pathways in surface soil: aluminum, beryllium, manganese, and thallium. The chemicals retained as COPCs in subsurface soil were aluminum, beryllium, and thallium.

5.2.4.1.3 *Bullet Stop*

Data Grouping. No data grouping was necessary as part of COPC selection at the Bullet Stop.

Frequency of Detection. No evaluation of detection frequency was undertaken in surface soil or subsurface soil at the Bullet Stop (maximum n = 15).

Nutrient Screening. The three nutrients detected above background in surface soil (see Table 5-45) had maximum detected values that were less than their respective nutrient screening values: magnesium (maximum—11,700 μg/g; screening value—1,000,000 μg/g), potassium (maximum—6,960 μg/g; screening value—150,000 μg/g), and sodium (maximum—614 μg/g; screening value—1,000,000 μg/g). Therefore, these nutrients were eliminated as COPCs in surface soil.

No nutrients were detected above background in subsurface soil.

Region III RBC Screening. The final step in the COPC selection process consisted of comparing the EPCs for remaining contaminants in surface and subsurface soil with Region III RBCs. However, before these comparisons were made, a "hot spot" analysis was conducted.

Hot Spot Analysis. For the final selection of COPCs, the site was evaluated for possible "hot spots." Each sample location was evaluated separately because of the large distance between locations with respect to a hypothetical residential lot, indicating a single sample may represent

the concentrations of contaminants to which receptors may be exposed. Screening the maximum above-background chemical concentrations at each location against the Region III RBCs revealed that no single location represented a risk that was significantly greater than site-wide average risks. Due to the small number of subsurface soil samples, the "site-wide" EPCs for subsurface soil would be the same as the maximum detected concentrations. Combining the samples did not result in fewer or different chemicals being carried forward in the risk assessment than would have been if individual locations were selected as hot spots. Therefore, all samples from the Bullet Stop were combined for the calculation of the EPCs. Table 5-46 provides a summary of the EPCs for preliminary COPCs in surface and subsurface soil at the Bullet Stop.

Soil-related Exposure Pathways. To select COPCs for the soil-related exposure pathways, the EPCs for the Bullet Stop in surface and subsurface soil were compared to Region III soil ingestion and soil-to-air RBCs. As shown in Table 5-47, thallium was the only chemical retained as a COPC for soil-related pathways in surface soil. The chemicals retained as COPCs in subsurface soil were arsenic and zinc.

5.2.4.1.4 ***Site-wide Soils.*** Concentrations of the COPCs for surface soils—aluminum, beryllium, manganese, and thallium—were calculated on a site-wide basis for the purpose of evaluating site-wide exposure scenarios. Site-wide concentrations were calculated utilizing all surface soil samples collected at SWMU 6. The site-wide concentrations of these surface soil COPCs are provided in Table 5-48.

5.2.4.2 *Selection of the Chemicals of Potential Concern—Groundwater*

The selection of COPCs for the groundwater exposure pathways consist of a two-phase modeling approach. Initially, the *maximum* concentration of each analyte detected in either surface or subsurface soil was compared to the Region III soil-to-groundwater RBC. One-tenth of the value was used for noncarcinogens. If the maximum concentration of a chemical exceeded the soil-to-groundwater RBC, the chemical was selected for vadose zone modeling (Table 5-49). The modeled break-through concentration in groundwater for these chemicals was then compared to the Region III tap water RBCs, with one-tenth of the value used for noncarcinogens. In addition, the modeled break-through time was compared to the 100-year cut-off period as described in Section 2.7.2. A chemical that reached the water table within 100 years *and* had a modeled break-through concentration that exceeded the Region III tap water RBC (one-tenth of the value for noncarcinogens) was retained for further vadose-saturated zone modeling to on- and off-site hypothetical receptors as described in Section 2.7.2. For this second phase of modeling, the *average* surface and subsurface soil concentration was used to calculate the initial pore water concentration at the site. Again, the vadose-saturated zone modeling results were compared to the Region III tap water RBCs, with one-tenth for noncarcinogens. If the chemical still failed to meet the 100-year break-through criteria *and* exceeded the Region III tap water RBC, it was retained for quantitative risk assessment. As shown in Table 5-49, the following chemicals were retained for vadose zone modeling at the three sites:

Table 5-48. Site-Wide Surface Soil Exposure Point Concentrations of Chemicals of Potential Concern (SWMU 7)

Chemical	Frequency of Detection[a]	Range of Detected Values (μg/g)	Range of Reporting Limits (μg/g)[b]	Arithmetic Mean Concentration (μg/g)	95% UCL Concentration (μg/g)	Exposure Point Concentration[c] (μg/g)
Aluminum	25/28	10,500 - 39,800	11.2	17,769	20,524	20,524
Beryllium	17/31	0.539 - 1.71	0.078 - 0.427	0.597	1.0	1.0
Manganese	24/28	237 - 732	9.87	414	2.75E+03	732
Thallium	4/31	35.8 - 40.2	34.3 - 175	25.4	30.8	30.8

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]Micrograms per gram.
[c]The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).

Table 5-49. Selection of COPCs for Groundwater Exposure Pathways (SMWU 7)

Chemical	Maximum Above Background (μg/g)[a]	Depth	Soil-to-GW RBC[b] (μg/g)	Selected for Vadose Zone Modeling?	Reached Water Table Within 100 Years	Model Output: Break-Through Point Concentration in Ground Water (mg/L[c])	Tap Water RBC (mg/L)	Selected as COPC for Groundwater?[d]
Firing Point								
Arsenic	17.5	Subsurface	15	YES	No	.028	.000038	No
Cadmium	21.6	Subsurface	0.6	YES	No	.106	.0018	No
Chromium	25.4	Surface	1.9	YES	No	.193	0.018	No
Cobalt	8.68	Subsurface	119[f]	No	---	--	---	---
Copper	99.6	Subsurface	31[f]	YES	No	.284	0.140	No
Lead	48.5	Subsurface	15	YES	No	.025	0.015[g]	No
Vanadium	29.9	Subsurface	5.2[f]	YES	No	---	0.026	No
Zinc	12,000	Subsurface	4,200	YES	No	53.4	1.100	No
Benzyl alcohol	0.079	Subsurface	2.5[f]	No	---	---	---	---
Butyl benzyl phthalate	0.292	Surface	6.8	No	---	---	---	---
Hexachlorobenzene	0.340	Subsurface	0.1	YES	No	.00016	.00014	No
Northwest Test Area Trench								
Aluminum	42,400	Subsurface	590[f,h]	YES	No	---	3.700	No
Barium	412	Surface	3.2	YES	No	.019	0.260	---
Beryllium	1.79	Subsurface	180	No	---	---	---	No
Cadmium	4.94	Surface	0.6	YES	No	.071	.0018	No
Chromium	38.3	Subsurface	1.9	YES	No	.847	.018	---
Cobalt	11.2	Surface	119[f]	No	---	---	---	---
Copper	26.6	Surface	31[f]	No	---	---	---	No
Lead	36.3	Surface	15	YES	No	.055	0.015[g]	No
Manganese	732	Surface	26[f,i]	YES	No	5.27	0.018	---
Mercury	0.119	Subsurface	0.3[f]	No	---	---	---	No
Nickel	27.0	Subsurface	2.1	YES	No	.0028	0.073	No
Thallium	55.3	Subsurface	0.04	YES	No	---	.00026[j]	No
Vanadium	49.4	Subsurface	5.2[f]	YES	No	---	0.026	-No
Zinc	811	Surface	4,200	No	---	---	---	---
Benzyl alcohol	0.061	Subsurface	2.5[f]	No	---	---	---	---

Table 5-49. Selection of COPCs for Groundwater Exposure Pathways (SMWU 7) (continued)

Chemical	Maximum Above Background (μg/g)[a]	Depth	Soil-to-GW RBC[b] (μg/g)	Selected for Vadose Zone Modeling?	Reached Water Table Within 100 Years	Model Output: Break-Through Point Concentration in Ground Water (mg/L[c])	Tap Water RBC (mg/L)	Selected as COPC for Groundwater?[d]
Bullet Stop								
Arsenic	17.6	Subsurface	15	YES	No	.276	.000038	No
Cadmium	1.56	Subsurface	0.6	YES	No	.074	.0018	No
Chromium	26.0	Surface	1.9	YES	No	1.904	.018	No
Cobalt	8.12	Surface	119[f]	No	---	---	---	---
Copper	26.3	Surface	31[f]	No	---	---	---	---
Lead	29.8	Surface	15	YES	No	1.51	.015[h]	No
Thallium	40.2	Surface	0.04	YES	No	---	.00026[i]	No
Vanadium	32.3	Surface	5.2[f]	YES	No	---	.026	No
Zinc	9,900	Subsurface	4,200	YES	No	236	1.100	No

Note.—RBCs were taken directly from the Region III RBC Table except as indicated in the footnotes.
[a]Micrograms per gram.
[b]Risk-based calculations.
[c]Milligrams per liter.
[d]Chemical was eliminated as a groundwater COPC if it reached the water table in more than 100 years or did not exceed the tap water RBC.
[e]Not applicable.
[f]Calculated according to Region III guidance (US EPA, 1995).
[g]Based on tap water value rather than 2° MCL.
[h] Action level for lead (US EPA, 1995??)
[i]Value for thallic oxide.

- Firing Point—arsenic, cadmium, chromium, copper, lead, vanadium, zinc, and hexachlorobenzene.

- Northwest Test Area Trench—aluminum, barium, cadmium, chromium, lead, manganese, nickel, thallium, and vanadium.

- Bullet Stop—arsenic, cadmium, chromium, lead, thallium, vanadium, and zinc.

5.2.4.2.1 ***Vadose Zone Model Results.*** The soil screening described in the previous sections indicated that the bullet stop area, the firing point area, and the northwest test area contain COPCs that should be evaluated using the soil-vadose-zone-groundwater-screening model. These COPCs consist primarily of metals with the exception of hexachlorobenzene at the firing point area. The vadose zone modeling set-up procedures are described in detail in Section 2.7.2 of this report. This section defines the site-specific parameters and presents the vadose-zone modeling results.

The SWMU 7 site-specific input parameters are defined as the thickness of the vadose zone (H cm), the area of contamination (CA m^2), and the thickness of the contaminated zone (H cont, cm). The vadose-zone thickness and the contaminated-soil thickness are the same for all three areas. However, the area of contaminated soil varies as shown below. These input parameters, along with the COPC chemical-specific parameters, are used as the input for the GWM-1 and MULTIMED models. GWM-1 spreadsheets for SWMU 7 are shown in Appendix K. The site-specific parameters for SWMU 7 are as follows:

H	=	8,200 cm
CA	=	429,200 m^2 (bullet stop area) 4,600 m^2 (firing point area) 38,900 m^2 (northwest test area)
H cont	=	305 cm

Other key COPC-specific parameters—the distribution coefficient (Kd), the maximum observed soil concentration (Tc), the initial pore water concentration (C_{init}), and the plume pulse duration (p.d.)—are also shown in Appendix K. All of the GWM-1 spreadsheets associated with the 15 SWMU-specific COPCs are in Appendix K. Tables 5-50, 5-51, and 5-52 summarize these COPC-specific parameters and show the MULTIMED output for COPC break-through time (time after leaching starts, that the leading edge of the COPC plume reaches the top of the water table) along with the COPC estimated concentration at the time that breakthrough occurs. One key to interpreting these estimates is that the pore water concentration was determined by starting with the *maximum* observed soil concentration measured at the site (see Table 5-46) and calculating the maximum concentration available for the pore water solution by soil-water partitioning. As explained in Section 2.7.2, the equation used is very dependent on Kd and does not take into account mineral solubility and equilibrium

Table 5-50. Summary of Vadose Zone Break-Through Modeling Results and Critical I/O GWM-1 and MULTIMED Parameters for SWMU 7 (Firing Point)

COPC[a] Specific Parameters						
Analyte	**Kd[b]**	**Tc[c] (max) (ppm)[d]**	**C_{init}[e] (mg/L)[f]**	**Breakthrough Time (yrs)**	**Breakthrough Conc. (mg/L)**	**p.d.[g] (yrs)**
Arsenic	1	17.5	17.5	650	0.028	58
Cadmium	1.3	21.6	17	850	0.106	74
Chromium	1.2	25.4	21.5	800	0.193	69
Copper	1.4	99.6	73.2	900	0.284	79
Lead	4.5	48.5	11.7	2750	0.025	242
Vanadium	1000	29.9	0.00332	>92000	ND[h]	52486
Zinc	1	12000	12000	660	53.4	58
Hexachlorobenzene	1.94	0.34	.18	1210	0.00016	108

Note.—Site-specific parameters are as follows: vadose zone thickness (H) = 8,200 cm; area of contaminated soil (CA) = 4,600 m^2; thickness of contaminated soil (Hcont) = 305 cm.

[a]Chemicals of potential concern.
[b]Distribution coefficient and is dimensionless.
[c]Maximum observed soil concentration (ppm).
[d]Parts per million.
[e]Pore water concentration at the source as conservatively calculated by GWM-1.
[f]Milligrams per liter.
[g]Pulse duration as calculated by GWM-1.
[h]Not determined.

Table 5-51. Summary of Vadose Zone Break-Through Modeling Results and Critical I/O GWM-1 and MULTIMED Parameters for SWMU 7 (Bullet Stop Area)

COPC[a] Specific Parameters						
Analyte	**Kd[b]**	**Tc[c] (max) (ppm)[d]**	**C_{init}[e] (mg/L)[f]**	**Breakthrough Time (yrs)**	**Breakthrough Conc. (mg/L)**	**p.d.[g] (yrs)**
Arsenic	1	17.6	17.6	650	0.276	58
Cadmium	1.3	1.56	1.23	850	0.074	74
Chromium	1.2	26	22	800	1.904	69
Lead	4.5	29.8	71.8	2750	1.51	242
Thallium	3200	40.2	0.014	>91000	ND[h]	167941
Vanadium	1000	32.3	0.0359	>91000	ND	52486
Zinc	1	9900	9900	653	236	58

Note.—Site-specific parameters are as follows: vadose zone thickness (H) = 8,200 cm; area of contaminated soil (CA) = 429,200 m^2; thickness of contaminated soil (Hcont) = 305 cm.

[a]Chemicals of potential concern.
[b]Distribution coefficient and is dimensionless.
[c]Maximum observed soil concentration (ppm).
[d]Parts per million.
[e]Pore water concentration at the source as conservatively calculated by GWM-1.
[f]Milligrams per liter.
[g]Pulse duration as calculated by GWM-1.
[h]Not determined.

Table 5-52. Summary of Vadose Zone Break-Through Modeling Results and Critical I/O GWM-1 and MULTIMED Parameters for SWMU 7 (Northwest Test Area Trench)

COPC[a] Specific Parameters						
Analyte	**Kd[b]**	**Tc[c] (max) (ppm)[d]**	**C_{init}[e] (mg/L)[f]**	**Breakthrough Time (yrs)**	**Breakthrough Conc. (mg/L)**	**p.d.[g] (yrs)**
Aluminum	1500	42400	31.4	>91000	ND	78726
Barium	52	412	7.62	31000	0.019	2735
Cadmium	1.3	4.96	3.91	850	0.071	74
Chromium	1.2	38.3	32.5	800	0.847	69
Lead	4.5	36.3	8.74	2750	0.055	242
Managanese	1	732	732	650	5.27	58
Nickel	150	27	0.2	91300	0.0028	7878
Thallium	3200	55.3	19.2	>91300	ND[h]	167941
Vanadium	1000	49.4	0.0549	>91300	ND	52486

Note.—Site-specific parameters are as follows: vadose zone thickness (H) = 8,200 cm; area of contaminated soil (CA) = 38,900 m^2; thickness of contaminated soil (Hcont) = 305 cm.

[a]Chemicals of potential concern.
[b]Distribution coefficient and is dimensionless.
[c]Maximum observed soil concentration (ppm).
[d]Parts per million.
[e]Pore water concentration at the source as conservatively calculated by GWM-1.
[f]Milligrams per liter.
[g]Pulse duration as calculated by GWM-1.
[h]Not determined.

relationships. This is evident by some of the high C_{init} concentrations estimated for several of the COPCs.

5.2.4.2.2 ***Groundwater COPCs.*** As shown in Tables 5-50, 5-51, and 5-52, the MULTIMED output indicates that within a 100-year time period none of the COPCs will travel downward through the vadose zone and reach the water table. As discussed in detail in Section 2.7.2, the conservative approach was the basis for the model calculations. Therefore, no potential COPCs for the groundwater pathway were considered for the quantitative risk assessment.

Tables 5-50, 5-51, and 5-52 show the critical input and output parameters and the estimated break-through time for each COPC. These tables also show the estimated concentration associated with the arrival of the leading edge of the COPC plume at the water table. Again, it should be noted that the break-through time calculation does not take into account the various retardation influences, such as biodegradation, volatilization, absorption, adsorption, and mineral-solution equilibrium relationship.

5.2.4.3 *Exposure Pathway Assessment*

Exposure is defined as the contact of a receptor with a chemical (USEPA 1989c). Exposure assessment is the estimation of the magnitude, frequency, and duration for each identified route of exposure. The magnitude of an exposure is determined by estimating the amount of chemical available at the receptor exchange boundaries (i.e., lungs, gastrointestinal tract, or skin) during a specified time period.

Section 3.1.2 describes the general tasks comprising the exposure assessment. The specific application of these tasks to SWMU 7 is described below.

5.2.4.3.1 ***Characterization of Exposure Setting.*** The first step in developing exposure scenarios for SWMU 7 was to characterize the site setting in which potential exposures might occur. The characteristics of the site setting influence the types of transport mechanisms and the type of receptor exposure that could occur. The site setting also provides a basis for identifying the potential receptors (either real or, in the case of site redevelopment for alternative use, hypothetical). Both current land use patterns and future land use patterns were examined as part of the characterization.

Current Land Use. As is true for other areas of TEAD-N, public access to SWMU 7 is controlled, thereby precluding transient exposure. SWMU 7 is located in the south-central portion of TEAD-N and will remain part of the depot mission for the foreseeable future. Data were not available on current use patterns of the Chemical Range.

Based on the above information, potential receptors under current land use were defined as:

- SWMU-specific laborers and security personnel—Individuals with job descriptions that call for repeated, light to moderate labor in the general vicinity of SWMU 7 and staff assigned to maintenance of the perimeter or security personnel that repeatedly work in the vicinity of SWMU 7.

- Off-site residents—Military personnel and/or civilians living near the depot perimeter.

It was assumed that the SWMU-specific laborer scenario would provide a sufficient upper bound for on-site risk to encompass intermittent trespassing. Because other potential receptors would be exposed only intermittently to SWMU 7, SWMU-specific laborers and security personnel were the only on-site receptors evaluated quantitatively as a current-use scenario. This approach provides a series of upper-bound estimates. Off-site residents living near the depot boundary may potentially be exposed to SWMU-related chemicals bound to resuspended particulate. Therefore, the inhalation pathway is quantitatively evaluated for these receptors.

Cattle grazing is permitted at TEAD-N, with grazing allotments competitively bid and leased every 5 years to a single rancher. The current lease is up for rebid in 1996. Grazing at TEAD-N typically occurs between October 15 and May 31, with calving taking place in January. The calves remain at the facility until May 31 when they are either moved to feedlots or to other grazing areas. The calves typically do not return to TEAD-N after their initial exposure, and they are eventually sold as slaughter cattle for human consumption. Distribution is through regional and national distribution networks. The cows are normally utilized as breeding stock and may or may not return to the site during consecutive years. The current lessee brings approximately 1,000 head, mostly heifers, to winter pasture at TEAD-N and maintains summer pasture in Idaho (M. Walker, personal communication with Rust E&I, 1994).

SWMU 7 is one of several SWMUs on one grazing allotment currently under lease. Consumption of beef grazed on the allotment of which SWMU 7 is a part is evaluated in a separate section (Section 5.7.1) of the risk assessment.

Future Land Use. No change in current use is planned for the Chemical Range; therefore, some exposure scenarios that are analogous to current-use scenarios described above will continue (e.g., SWMU-specific laborers and security personnel). Current BRAC recommendations retain SWMU 7's function as part of the depot's mission. However, should the mission of TEAD-N change in the future, two additional exposure scenarios unique to planned or potential future use of SWMU 7 were developed:

- Skilled laborers—Individuals assigned to short-term construction in the vicinity of SWMU 7 during potential redevelopment.

- Inhabitants of an on-site residence(s)—Individuals who live in residences established at the time that depot property should ever be transferred for redevelopment.

5.2.4.3.2 ***Characterization of Potential Exposure Pathways.*** An exposure pathway is the route COPCs take to reach potential receptors. Sections 3.1.2.1 and 3.1.2.2 describe the methodology for characterization of exposure pathways. This methodology was then applied to SWMU 7. The following sections describe the potential exposure pathways associated with SWMU 7 for the current and future land use scenarios.

Current Land Use. Currently, the majority of laborers at TEAD-N work 10-hour days with 4-day weeks. A total of 4 weeks off a year for vacation, holidays, and sick leave yields 192 days per year on the job. It is assumed that a laborer could be at any specific SWMU from 2 (CTE) to 10 (RME) hours per day and will incidentally ingest, inhale, or become in contact with surface soil through worker-related activities. Military personnel are rotated on assignment an average of every 3 years (S. Culley, personal communication with Rust E&I, 1994). If a laborer is a civilian, the length of assignment could be expected to range as high as 25 years. It is assumed that all of the exposure is from outdoor tasks or activities. Specific parameters relating to ingestion, contact, and ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

For the current off-site adult resident, it was assumed that at least one parent would spend much of his or her time away from home in activities such as working at another location, household errands, personal care (e.g., medical/dental appointments), or leisure activities. Based on this assumption, the total estimated time an adult spends at home is approximately 15 to 19 hours per day during which time he or she may inhale particulates generated from surface soil associated with SWMU 7 while conducting activities such as gardening, mowing, or outdoor sports. For children ages 0 to 18, time activity patterns indicate that they spend an average of approximately 30 hours per week away from home to attend school or day care. The total time a child spends at home averaged over a 7-day week is 20 hours per day. It is assumed that residents spend 2 (RME) to 4 (CTE) weeks away from home on vacation or long holiday weekends. Therefore, the exposure frequency in real time is 335 days per year (CTE) to 350 days per year (RME). Because the contact rate for ingestion and dermal exposure is in daily units, the exposure frequency for these pathways is prorated into 24-hour day equivalents. This ranges from 216 (CTE adult) to 276 days per year (CTE child) and 273 (RME adult) to 288 days per year (RME child) (see Appendix L). Years spent at one residence for the adult/child range from 8 (CTE) to 30 (RME) years based on studies compiled by the USEPA (1989c) and AIHC (1994). Specific parameters relating to ventilation rates, body weights, and bioavailability are given in Appendix L.

Future Land Use. Current BRAC recommendations retain SWMU 7's function as part of the depot's mission. Based on the future continued usage of SWMU 7, it is possible that industrial construction may be conducted to increase the capacity of the military operations at TEAD-N. For these reasons, the future construction worker scenario was evaluated. It is assumed that a construction company could be contracted for a work period ranging from 1 to 3 years and a single worker could be at the site conducting activities outdoors from 2 to 4 months of the year. It is assumed that a worker works as much as 8 to 10 hours per day and may incidentally ingest, inhale, or come in contact with subsurface soil through construction-related activities. Specific parameters relating to ingestion, contact, and ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

Should the future planned use of SWMU 7 change and the property be zoned for potential residential development, the future on-site adult and child resident are also evaluated for the future land use scenario. For the future on-site adult resident, it was assumed that at least one parent would spend much of his or her time away from home in activities such as working at another location, household errands, personal care (e.g., medical/dental appointments), or leisure activities. Based on this assumption, the total estimated time an adult will spend at home is approximately 15 to 19 hours per day during which time he or she may incidentally ingest, inhale, or come in contact with surface soil while conducting activities such as gardening, mowing, or outdoor sports. It is also expected that the future on-site resident will grow and harvest vegetables and fruits from a home garden. For children and adolescents ages 0 to 18, time activity patterns indicate that they spend an average of approximately 30 hours per week away from home to attend school or day care. The total time a child spends at home, averaged over a 7-day week, is approximately 20 hours per day. It is assumed that residents spend 2 (RME) to 4 (CTE) weeks away from home on vacation or long holiday weekends. Therefore, the exposure frequency in real time is 335 days per year (CTE) to 350 days per year (RME). Because the contact rate for ingestion and dermal exposure is in daily units, the exposure frequency for these pathways is prorated into 24-hour-day equivalents. This ranges from 216 days per year (CTE adult) to 276 days per year (CTE child) and from 273 days per year (RME adult) to 288 days per year (RME child) (see Appendix L). Years spent at one residence for the adult/child range from 8 (CTE) to 30 (RME) years based on studies compiled by the USEPA (1989c) and AIHC (1994). Specific parameters relating to ingestion, contact, ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

5.2.4.3.3 ***Exposure Point Concentrations*****.** The EPC is defined as the concentration of a COPC in an exposure medium that will be contacted over a real or hypothetical exposure duration. EPCs at SWMU 7 were evaluated for current and future land use. Estimation of EPCs is fully described in Appendix L. For brevity, only information specific to SWMU 7 is presented in the following sections.

As discussed in Sections 5.2.4.1 and 5.2.4.2, three areas of concern were evaluated for SWMU 7. Based on the screening methodology, EPCs were estimated for COPCS in surface and/or subsurface soils for all areas of concern—Firing Point, Northwest Test Area Trench, and Bullet Stop—as well as the SWMU as a whole.

Current Land Use**.** EPCs for surface soil ingestion and dermal contact by the SWMU 7 personnel were estimated for the CTE and RME exposure scenario from Phase I and II RI data. Because the duties of on-site personnel vary, EPCs were developed for each area of concern and the SWMU as a whole to encompass all potential exposure scenarios for this receptor.

EPCs in air for on-site personnel and off-site residents were estimated using USEPA's SCREEN2 model. Air emissions were not evaluated for each specific area of concern. It was assumed that the SWMU, as a whole, was the main source for air emission generation for all on- and off-site receptors. Details of the estimation of emission rates from surface soils and

dispersion modeling are described in Appendix N. Tables 5-53 through 5-58 present the EPCs for on-site personnel and off-site residents associated with SWMU 7.

Future Land Use. EPCs for subsurface soil ingestion and dermal contact by hypothetical future on-site construction workers at SWMU 7 were estimated using the same methods as those used for the on-site personnel under the current land use scenario. However, it was assumed that the construction projects would be limited in size, therefore, potential exposure pathways are not evaluated for the SWMU as a whole but are limited to the specific areas of concern (Tables 5-53 through 5-56). EPCs for inhalation of particulates were modeled, as described in Appendix N, for the hypothetical on-site construction worker (see Appendix L).

EPCs for surface soil ingestion, dermal contact and produce ingestion by hypothetical future on-site residents at SWMU 7 were estimated using methods described in Appendix L. The EPCs are given in Tables 5-53 through 5-58.

5.2.4.3.4 ***Estimation of Chemical Intakes***. The exposure models described in detail in Appendix L together with EPCs listed in Tables 5-53 through 5-58 were used to estimate intake for the potential exposure scenarios. Note that averaging time differs for carcinogens and noncarcinogens. Estimates of exposure intakes are given in Tables 5-59 through 5-82.

5.2.4.4 *Toxicity Assessment*

Information of the toxicological effects of carcinogenic and systemic toxicants are summarized in Appendix M. This toxicity assessment includes brief toxicity profiles on data listed in USEPA's IRIS database and published in HEAST (USEPA 1994c). These profiles describe the acute, chronic, and carcinogenic health effects associated with SWMU-related chemicals. Toxicity values for COPCS associated with SWMU 7 are summarized in Tables 5-59 through 5-82.

5.2.4.5 *Risk Characterization*

This section provides a characterization of the potential health risks using the intake of chemicals associated with three areas of concern associated with SWMU 7—Firing Point, Northwest Test Area Trench, and Bullet Stop. In addition, potential risks were evaluated for SWMU 7 as a whole. The risk characterization compares estimated potential ILCRs with reasonable levels of risk for potential carcinogens (see Section 3.1.4.1), and the estimated daily intake of systemic toxicants with appropriate reference levels. Some carcinogenic chemicals may also pose a systemic hazard, and these potential hazards are characterized as for other systemic toxicants. Each of the areas associated with SWMU 7 are discussed separately below.

Table 5-53. Adult Exposure Point Concentrations for the Firing Point Area of Concern Associated with SWMU 7

	Exposure Point Concentration	
Chemical	**CTE**	**RME**
Future Land Use [(a)]		
Subsurface Soil (mg/kg)		
Arsenic	16.7	16.7
Air Emissions ($\mu g/m^3$)		
Arsenic	0.23	0.23

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Table 5-54. Adult Exposure Point Concentrations for the Northwest Test Area Trench Area of Concern Associated with SWMU 7

Chemical	Exposure Point Concentration CTE	Exposure Point Concentration RME
Current Land Use		
Surface Soil (mg/kg)		
Aluminum	26,263	26,263
Beryllium	1.16	1.16
Manganese	601	601
Thallium	30	30
Air Emissions ($\mu g/m^3$)		
Aluminum	3.61	3.61
Beryllium	0.00018	0.00018
Manganese	0.13	0.13
Thallium	0.0054	0.0054
Future Land Use [a]		
Surface Soil (mg/kg)[b]		
Air Emissions from Surface Soil (mg/m^3)[b]		
Subsurface Soil (mg/kg)		
Aluminum	42,400	42,400
Beryllium	1.79	1.79
Thallium	41.6	41.6
Air Emissions from Subsurface Soil ($\mu g/m^3$)		
Aluminum	575	575
Beryllium	0.024	0.024
Thallium	0.56	0.56
Tubers/Fruits (mg/kg)		
Aluminum	3.76	3.76
Beryllium	0.00038	0.00038
Manganese	6.61	6.61
Thallium	0.0026	0.0026
Leafy Vegetables (mg/kg)		
Aluminum	7.35	7.35
Beryllium	0.00081	0.00081
Manganese	10.5	10.5
Thallium	0.0084	0.0084

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.
[b]Future use concentrations are the same as for the current use scenarios.

Table 5-55. Child Exposure Point Concentrations for the Northwest Test Area Trench Area of Concern Associated with SWMU 7

	Exposure Point Concentration	
Chemical	**CTE**	**RME**
Future Land Use [(a)]		
Surface Soil (mg/kg)		
Aluminum	26,263	26,263
Beryllium	1.16	1.16
Manganese	601	601
Thallium	30	30
Air Emissions ($\mu g/m^3$)		
Aluminum	3.61	3.61
Beryllium	0.00018	0.00018
Manganese	0.13	0.13
Thallium	0.0054	0.0054
Tubers/Fruits (mg/kg)		
Aluminum	3.76	3.76
Beryllium	0.00038	0.00038
Manganese	6.61	6.61
Thallium	0.0026	0.0026
Leafy Vegetables (mg/kg)		
Aluminum	7.35	7.35
Beryllium	0.00081	0.00081
Manganese	10.5	10.5
Thallium	0.0084	0.0084

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Table 5-56. Adult Exposure Point Concentrations for the Bullet Stop Area of Concern Associated with SWMU 7

Chemical	Exposure Point Concentration CTE	Exposure Point Concentration RME
Current Land Use		
Surface Soil (mg/kg)		
Thallium	20.8	20.8
Air Emissions ($\mu g/m^3$)		
Aluminum	3.61	3.61
Beryllium	0.00018	0.00018
Manganese	0.13	0.13
Thallium	0.0054	0.0054
Future Land Use [(a)]		
Surface Soil (mg/kg)[(b)]		
Air Emissions from Surface Soil ($\mu g/m^3$)[(b)]		
Subsurface Soil (mg/kg)		
Arsenic	17.6	17.6
Zinc	9,900	9,900
Air Emissions from Subsurface Soil ($\mu g/m^3$)		
Arsenic	0.24	0.24
Zinc	134	134
Tubers/Fruits (mg/kg)		
Thallium	0.0018	0.0018
Leafy Vegetables (mg/kg)		
Thallium	0.0058	0.0058

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

[b]Future use concentrations are the same as for the current use scenarios.

Table 5-57. Child Exposure Point Concentrations for the Bullet Stop Area of Concern Associated with SWMU 7

Chemical	Exposure Point Concentration CTE	Exposure Point Concentration RME
Future Land Use [(a)]		
Surface Soil (mg/kg)		
Thallium	20.8	20.8
Air Emissions ($\mu g/m^3$)		
Aluminum	3.61	3.61
Beryllium	0.00018	0.00018
Manganese	0.13	0.13
Thallium	0.0054	0.0054
Tubers/Fruits (mg/kg)		
Thallium	0.0018	0.0018
Leafy Vegetables (mg/kg)		
Thallium	0.0058	0.0058

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Table 5-58. Adult Exposure Point Concentrations for SWMU 7 as a Whole

Chemical	Exposure Point Concentration CTE	Exposure Point Concentration RME
Current Land Use		
Surface Soil (mg/kg)		
Aluminum	20,524	20,524
Beryllium	1.0	1.0
Manganese	732	732
Thallium	30.8	30.8
On-site Air Emissions ($\mu g/m^3$)		
Aluminum	3.61	3.61
Beryllium	0.00018	0.00018
Manganese	0.13	0.13
Thallium	0.0054	0.0054
Off-site Air Emissions ($\mu g/m^3$)[a]		
Aluminum	3.55	3.55
Beryllium	0.00017	0.00017
Manganese	0.13	0.13
Thallium	0.0053	0.0053

[a]Exposure point concentrations are the same for the child and adult off-site resident.

Table 5-59. Summary of Potential Carcinogenic Risk Results for the Future Construction Worker for SWMU 7 (Firing Point)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Subsurface Soil					
Arsenic	1.7E+01	1.2E-07	1.5E+00	1.8E-07	
			Pathway Total:	1.8E-07	35.6%
Dermal Contact with Subsurface Soil					
Arsenic	1.7E+01	4.3E-10	1.5E+00	6.6E-10	
			Pathway Total:	6.6E-10	0.1%
Inhalation of Particulates					
Arsenic	2.3E-04	2.2E-08	1.5E+01	3.3E-07	
			Pathway Total:	3.3E-07	64.2%
			Total CTE ILCR:	5.1E-07	100.0%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Subsurface Soil					
Arsenic	1.7E+01	1.7E-06	1.5E+00	2.6E-06	
			Pathway Total:	2.6E-06	36.8%
Dermal Contact with Subsurface Soil					
Arsenic	1.7E+01	3.0E-08	1.5E+00	4.6E-08	
			Pathway Total:	4.6E-08	0.7%
Inhalation of Particulates					
Arsenic	2.3E-04	2.9E-07	1.5E+01	4.3E-06	
			Pathway Total:	4.3E-06	62.5%
			Total RME ILCR:	6.9E-06	100.0%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

Table 5-60. Summary of Potential Carcinogenic Risk Results for the Current/Future On-Site Laborer for SWMU 7 (Northwest Test Area Trench)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Aluminum	2.6E+04	NA[d]	NA	NA	
Beryllium	1.2E+00	1.1E-10	4.3E+00	4.7E-10	
Manganese	6.0E+02	NA	NA	NA	
Thallium	3.0E+01	NA	NA	NA	
			Pathway Total:	4.7E-10	2.0%
Dermal Contact with Surface Soil					
Aluminum	2.6E+04	NA	NA	NA	
Beryllium	1.2E+00	5.5E-12	4.3E+03	2.4E-08	
Manganese	6.0E+02	NA	NA	NA	
Thallium	3.0E+01	NA	NA	NA	
			Pathway Total:	2.4E-08	97.8%
Inhalation of Particulates					
Aluminum	3.6E-03	NA	NA	NA	
Beryllium	1.8E-07	8.0E-12	8.4E+00	6.8E-11	
Manganese	1.3E-04	NA	NA	NA	
Thallium	5.4E-06	NA	NA	NA	
			Pathway Total:	6.8E-11	0.3%
			Total CTE ILCR:	2.4E-08	100.0%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Aluminum	2.6E+04	NA	NA	NA	
Beryllium	1.2E+00	8.8E-08	4.3E+00	3.8E-07	
Manganese	6.0E+02	NA	NA	NA	
Thallium	3.0E+01	NA	NA	NA	
			Pathway Total:	3.8E-07	0.9%
Dermal Contact with Surface Soil					
Aluminum	2.6E+04	NA	NA	NA	
Beryllium	1.2E+00	1.0E-08	4.3E+03	4.4E-05	
Manganese	6.0E+02	NA	NA	NA	
Thallium	3.0E+01	NA	NA	NA	
			Pathway Total:	4.4E-05	99.1%
Inhalation of Particulates					
Aluminum	3.6E-03	NA	NA	NA	
Beryllium	1.8E-07	1.9E-09	8.4E+00	1.6E-08	
Manganese	1.3E-04	NA	NA	NA	
Thallium	5.4E-06	NA	NA	NA	
			Pathway Total:	1.6E-08	0.04%
			Total RME ILCR:	4.5E-05	100.0%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-61. Summary of Potential Carcinogenic Risk Results for the Future On-Site Adult Resident for SWMU 7 (Northwest Test Area Trench)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) (mg/kg-day)-1	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Aluminum	2.6E+04	NA(d)	NA	NA	
Beryllium	1.2E+00	1.0E-08	4.3E+00	4.4E-08	
Manganese	6.0E+02	NA	NA	NA	
Thallium	3.0E+01	NA	NA	NA	
			Pathway Total:	4.4E-08	1.8%
Dermal Contact with Surface Soil					
Aluminum	2.6E+04	NA	NA	NA	
Beryllium	1.2E+00	5.1E-10	4.3E+03	2.2E-06	
Manganese	6.0E+02	NA	NA	NA	
Thallium	3.0E+01	NA	NA	NA	
			Pathway Total:	2.2E-06	92.3%
Inhalation of Particulates					
Aluminum	3.6E-03	NA	NA	NA	
Beryllium	1.8E-07	6.4E-10	8.4E+00	5.4E-09	
Manganese	1.3E-04	NA	NA	NA	
Thallium	5.4E-06	NA	NA	NA	
			Pathway Total:	5.4E-09	0.2%
Ingestion of Leafy Vegetables					
Aluminum	7.4E+00	NA	NA	NA	
Beryllium	8.1E-04	1.2E-08	4.3E+00	5.2E-08	
Manganese	1.1E+01	NA	NA	NA	
Thallium	8.4E-03	NA	NA	NA	
			Pathway Total:	5.2E-08	2.2%
Ingestion of Tubers and Fruits					
Aluminum	3.8E+00	NA	NA	NA	
Beryllium	3.8E-04	1.9E-08	4.3E+00	8.2E-08	
Manganese	6.6E+00	NA	NA	NA	
Thallium	2.6E-03	NA	NA	NA	
			Pathway Total:	8.2E-08	3.5%
			Total CTE ILCR:	2.4E-06	100.0%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Aluminum	2.6E+04	NA	NA	NA	
Beryllium	1.2E+00	2.4E-07	4.3E+00	1.0E-06	
Manganese	6.0E+02	NA	NA	NA	
Thallium	3.0E+01	NA	NA	NA	
			Pathway Total:	1.0E-06	0.8%
Dermal Contact with Surface Soil					
Aluminum	2.6E+04	NA	NA	NA	
Beryllium	1.2E+00	2.8E-08	4.3E+03	1.2E-04	
Manganese	6.0E+02	NA	NA	NA	
Thallium	3.0E+01	NA	NA	NA	
			Pathway Total:	1.2E-04	97.7%
Inhalation of Particulates					
Aluminum	3.6E-03	NA	NA	NA	
Beryllium	1.8E-07	3.4E-09	8.4E+00	2.8E-08	
Manganese	1.3E-04	NA	NA	NA	
Thallium	5.4E-06	NA	NA	NA	
			Pathway Total:	2.8E-08	0.02%
Ingestion of Leafy Vegetables					
Aluminum	7.4E+00	NA	NA	NA	
Beryllium	8.1E-04	1.6E-07	4.3E+00	6.8E-07	
Manganese	1.1E+01	NA	NA	NA	
Thallium	8.4E-03	NA	NA	NA	
			Pathway Total:	6.8E-07	0.6%
Ingestion of Tubers and Fruits					
Aluminum	3.8E+00	NA	NA	NA	
Beryllium	3.8E-04	2.5E-07	4.3E+00	1.1E-06	
Manganese	6.6E+00	NA	NA	NA	
Thallium	2.6E-03	NA	NA	NA	
			Pathway Total:	1.1E-06	0.9%
			Total RME ILCR:	1.2E-04	100.0%

[a] Units for the inhalation pathway are mg/m^3.

[b] See Appendix L for sources and methodology on estimating a daily intake value.

[c] See Appendix M for sources and methodology of toxicity values.

[d] NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-62. Summary of Potential Carcinogenic Risk Results for the Future On-Site Child Resident for SWMU 7 (Northwest Test Area Trench)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) (mg/kg-day)-1	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Aluminum	2.6E+04	NA[d]	NA	NA	
Beryllium	1.2E+00	4.6E-08	4.3E+00	2.0E-07	
Manganese	6.0E+02	NA	NA	NA	
Thallium	3.0E+01	NA	NA	NA	
			Pathway Total:	2.0E-07	4.8%
Dermal Contact with Surface Soil					
Aluminum	2.6E+04	NA	NA	NA	
Beryllium	1.2E+00	8.6E-10	4.3E+03	3.7E-06	
Manganese	6.0E+02	NA	NA	NA	
Thallium	3.0E+01	NA	NA	NA	
			Pathway Total:	3.7E-06	89.3%
Inhalation of Particulates					
Aluminum	3.6E-03	NA	NA	NA	
Beryllium	1.8E-07	3.3E-09	8.4E+00	2.7E-08	
Manganese	1.3E-04	NA	NA	NA	
Thallium	5.4E-06	NA	NA	NA	
			Pathway Total:	2.7E-08	0.7%
Ingestion of Leafy Vegetables					
Aluminum	7.4E+00	NA	NA	NA	
Beryllium	8.1E-04	2.0E-08	4.3E+00	8.5E-08	
Manganese	1.1E+01	NA	NA	NA	
Thallium	8.4E-03	NA	NA	NA	
			Pathway Total:	8.5E-08	2.1%
Ingestion of Tubers and Fruits					
Aluminum	3.8E+00	NA	NA	NA	
Beryllium	3.8E-04	3.1E-08	4.3E+00	1.3E-07	
Manganese	6.6E+00	NA	NA	NA	
Thallium	2.6E-03	NA	NA	NA	
			Pathway Total:	1.3E-07	3.2%
			Total CTE ILCR:	4.1E-06	100.0%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Aluminum	2.6E+04	NA	NA	NA	
Beryllium	1.2E+00	5.1E-07	4.3E+00	2.2E-06	
Manganese	6.0E+02	NA	NA	NA	
Thallium	3.0E+01	NA	NA	NA	
			Pathway Total:	2.2E-06	4.1%
Dermal Contact with Surface Soil					
Aluminum	2.6E+04	NA	NA	NA	
Beryllium	1.2E+00	1.2E-08	4.3E+03	5.0E-05	
Manganese	6.0E+02	NA	NA	NA	
Thallium	3.0E+01	NA	NA	NA	
			Pathway Total:	5.0E-05	93.7%
Inhalation of Particulates					
Aluminum	3.6E-03	NA	NA	NA	
Beryllium	1.8E-07	5.3E-09	8.4E+00	4.5E-08	
Manganese	1.3E-04	NA	NA	NA	
Thallium	5.4E-06	NA	NA	NA	
			Pathway Total:	4.5E-08	0.1%
Ingestion of Leafy Vegetables					
Aluminum	7.4E+00	NA	NA	NA	
Beryllium	8.1E-04	1.0E-07	4.3E+00	4.5E-07	
Manganese	1.1E+01	NA	NA	NA	
Thallium	8.4E-03	NA	NA	NA	
			Pathway Total:	4.5E-07	0.8%
Ingestion of Tubers and Fruits					
Aluminum	3.8E+00	NA	NA	NA	
Beryllium	3.8E-04	1.6E-07	4.3E+00	7.1E-07	
Manganese	6.6E+00	NA	NA	NA	
Thallium	2.6E-03	NA	NA	NA	
			Pathway Total:	7.1E-07	1.3%
			Total RME ILCR:	5.4E-05	100.0%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-63. Summary of Potential Carcinogenic Risk Results for the Future Construction Worker for SWMU 7 (Northwest Test Area Trench)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Subsurface Soil					
Aluminum	4.2E+04	NA(d)	NA	NA	
Beryllium	1.8E+00	1.3E-08	4.3E+00	5.6E-08	
Thallium	4.2E+01	NA	NA	NA	
			Pathway Total:	5.6E-08	20%
Dermal Contact with Subsurface Soil					
Aluminum	4.2E+04	NA	NA	NA	
Beryllium	1.8E+00	4.7E-11	4.3E+03	2.0E-07	
Thallium	4.2E+01	NA	NA	NA	
			Pathway Total:	2.0E-07	72%
Inhalation of Particulates					
Aluminum	5.8E-01	NA	NA	NA	
Beryllium	2.4E-05	2.4E-09	8.4E+00	2.0E-08	
Thallium	5.6E-04	NA	NA	NA	
			Pathway Total:	2.0E-08	7%
			Total CTE ILCR:	2.8E-07	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Subsurface Soil					
Aluminum	4.2E+04	NA	NA	NA	
Beryllium	1.8E+00	1.8E-07	4.3E+00	7.9E-07	
Thallium	4.2E+01	NA	NA	NA	
			Pathway Total:	7.9E-07	5%
Dermal Contact with Subsurface Soil					
Aluminum	4.2E+04	NA	NA	NA	
Beryllium	1.8E+00	3.2E-09	4.3E+03	1.4E-05	
Thallium	4.2E+01	NA	NA	NA	
			Pathway Total:	1.4E-05	93%
Inhalation of Particulates					
Aluminum	5.8E-01	NA	NA	NA	
Beryllium	2.4E-05	3.1E-08	8.4E+00	2.6E-07	
Thallium	5.6E-04	NA	NA	NA	
			Pathway Total:	2.6E-07	2%
			Total RME ILCR:	1.5E-05	100%

[a] Units for the inhalation pathway are mg/m^3.

[b] See Appendix L for sources and methodology on estimating a daily intake value.

[c] See Appendix M for sources and methodology of toxicity values.

[d] NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-64. Summary of Potential Carcinogenic Risk Results for the Current/Future On-Site Laborer for SWMU 7 (Bullet Stop)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) (mg/kg-day)$^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Thallium	2.1E+01	NA(d)	NA	NA	
			Pathway Total:	NA	NA
Dermal Contact with Surface Soil					
Thallium	2.1E+01	NA	NA	NA	
			Pathway Total:	NA	NA
Inhalation of Particulates					
Aluminum	3.6E-03	NA	NA	NA	
Beryllium	1.8E-07	8.0E-12	8.4E+00	6.8E-11	
Manganese	1.3E-04	NA	NA	NA	
Thallium	5.4E-06	NA	NA	NA	
			Pathway Total:	6.8E-11	100%
			Total CTE ILCR:	6.8E-11	NA
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Thallium	2.1E+01	NA	NA	NA	
			Pathway Total:	NA	NA
Dermal Contact with Surface Soil					
Thallium	2.1E+01	NA	NA	NA	
			Pathway Total:	NA	NA
Inhalation of Particulates					
Aluminum	3.6E-03	NA	NA	NA	
Beryllium	1.8E-07	1.9E-09	8.4E+00	1.6E-08	
Manganese	1.3E-04	NA	NA	NA	
Thallium	5.4E-06	NA	NA	NA	
			Pathway Total:	1.6E-08	100%
			Total RME ILCR:	1.6E-08	NA

[a] Units for the inhalation pathway are mg/m^3.
[b] See Appendix L for sources and methodology on estimating a daily intake value.
[c] See Appendix M for sources and methodology of toxicity values.
[d] NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-65. Summary of Potential Carcinogenic Risk Results for the Future On-Site Adult Resident for SWMU 7 (Bullet Stop)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Thallium	2.1E+01	NA[d]	NA	NA	
			Pathway Total:	NA	NA
Dermal Contact with Surface Soil					
Thallium	2.1E+01	NA	NA	NA	
			Pathway Total:	NA	NA
Inhalation of Particulates					
Aluminum	3.6E-03	NA	NA	NA	
Beryllium	1.8E-07	6.4E-10	8.4E+00	5.4E-09	
Manganese	1.3E-04	NA	NA	NA	
Thallium	5.4E-06	NA	NA	NA	
			Pathway Total:	5.4E-09	100%
Ingestion of Leafy Vegetables					
Thallium	5.8E-03	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Tubers and Fruits					
Thallium	1.8E-03	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE ILCR:	5.4E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Thallium	2.1E+01	NA	NA	NA	
			Pathway Total:	NA	NA
Dermal Contact with Surface Soil					
Thallium	2.1E+01	NA	NA	NA	
			Pathway Total:	NA	NA
Inhalation of Particulates					
Aluminum	3.6E-03	NA	NA	NA	
Beryllium	1.8E-07	3.4E-09	8.4E+00	2.8E-08	
Manganese	1.3E-04	NA	NA	NA	
Thallium	5.4E-06	NA	NA	NA	
			Pathway Total:	2.8E-08	100%
Ingestion of Leafy Vegetables					
Thallium	5.8E-03	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Tubers and Fruits					
Thallium	1.8E-03	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME ILCR:	2.8E-08	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-66. Summary of Potential Carcinogenic Risk Results for the Future On-Site Child Resident for SWMU 7 (Bullet Stop)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Thallium	2.1E+01	NA[d]	NA	NA	
			Pathway Total:	NA	NA
Dermal Contact with Surface Soil					
Thallium	2.1E+01	NA	NA	NA	
			Pathway Total:	NA	NA
Inhalation of Particulates					
Aluminum	3.6E-03	NA	NA	NA	
Beryllium	1.8E-07	3.3E-09	8.4E+00	2.7E-08	
Manganese	1.3E-04	NA	NA	NA	
Thallium	5.4E-06	NA	NA	NA	
			Pathway Total:	2.7E-08	100%
Ingestion of Leafy Vegetables					
Thallium	5.8E-03	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Tubers and Fruits					
Thallium	1.8E-03	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE ILCR:	2.7E-08	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Thallium	2.1E+01	NA	NA	NA	
			Pathway Total:	NA	NA
Dermal Contact with Surface Soil					
Thallium	2.1E+01	NA	NA	NA	
			Pathway Total:	NA	NA
Inhalation of Particulates					
Aluminum	3.6E-03	NA	NA	NA	
Beryllium	1.8E-07	5.3E-09	8.4E+00	4.5E-08	
Manganese	1.3E-04	NA	NA	NA	
Thallium	5.4E-06	NA	NA	NA	
			Pathway Total:	4.5E-08	100%
Ingestion of Leafy Vegetables					
Thallium	5.8E-03	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Tubers and Fruits					
Thallium	1.8E-03	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME ILCR:	4.5E-08	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-67. Summary of Potential Carcinogenic Risk Results for the Future Construction Worker for SWMU 7 (Bullet Stop)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Subsurface Soil					
Arsenic	1.8E+01	1.3E-07	1.5E+00	1.9E-07	
Zinc	9.9E+03	NA(d)	NA	NA	
			Pathway Total:	1.9E-07	35.6%
Dermal Contact with Subsurface Soil					
Arsenic	1.8E+01	4.6E-10	1.5E+00	6.9E-10	
Zinc	9.9E+03	NA	NA	NA	
			Pathway Total:	6.9E-10	0.1%
Inhalation of Particulates					
Arsenic	2.4E-04	2.3E-08	1.5E+01	3.5E-07	
Zinc	1.3E-01	NA	NA	NA	
			Pathway Total:	3.5E-07	64.2%
			Total CTE ILCR:	5.4E-07	100.0%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Subsurface Soil					
Arsenic	1.8E+01	1.8E-06	1.5E+00	2.7E-06	
Zinc	9.9E+03	NA	NA	NA	
			Pathway Total:	2.7E-06	36.8%
Dermal Contact with Subsurface Soil					
Arsenic	1.8E+01	3.2E-08	1.5E+00	4.8E-08	
Zinc	9.9E+03	NA	NA	NA	
			Pathway Total:	4.8E-08	0.7%
Inhalation of Particulates					
Arsenic	2.4E-04	3.0E-07	1.5E+01	4.6E-06	
Zinc	1.3E-01	NA	NA	NA	
			Pathway Total:	4.6E-06	62.5%
			Total RME ILCR:	7.3E-06	100.0%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-68. Summary of Potenital Carcinogenic Risk Results for the Current/Future On-site Laborer for SWMU 7 as a Whole

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Aluminum	2.1E+04	NA[d]	NA	NA	
Beryllium	1.0E+00	9.5E-11	4.3E+00	4.1E-10	
Manganese	7.3E+02	NA	NA	NA	
Thallium	3.1E+01	NA	NA	NA	
			Pathway Total:	4.1E-10	2.0%
Dermal Contact with Surface Soil					
Aluminum	2.1E+04	NA	NA	NA	
Beryllium	1.0E+00	4.8E-12	4.3E+03	2.0E-08	
Manganese	7.3E+02	NA	NA	NA	
Thallium	3.1E+01	NA	NA	NA	
			Pathway Total:	2.0E-08	97.7%
Inhalation of Particulates					
Aluminum	3.6E-03	NA	NA	NA	
Beryllium	1.8E-07	8.2E-12	8.4E+00	6.9E-11	
Manganese	1.3E-04	NA	NA	NA	
Thallium	5.4E-06	NA	NA	NA	
			Pathway Total:	6.9E-11	0.3%
			Total CTE ILCR:	2.1E-08	100.0%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Aluminum	2.1E+04	NA	NA	NA	
Beryllium	1.0E+00	7.6E-08	4.3E+00	3.3E-07	
Manganese	7.3E+02	NA	NA	NA	
Thallium	3.1E+01	NA	NA	NA	
			Pathway Total:	3.3E-07	0.9%
Dermal Contact with Surface Soil					
Aluminum	2.1E+04	NA	NA	NA	
Beryllium	1.0E+00	8.9E-09	4.3E+03	3.8E-05	
Manganese	7.3E+02	NA	NA	NA	
Thallium	3.1E+01	NA	NA	NA	
			Pathway Total:	3.8E-05	99.1%
Inhalation of Particulates					
Aluminum	3.6E-03	NA	NA	NA	
Beryllium	1.8E-07	2.0E-09	8.4E+00	1.7E-08	
Manganese	1.3E-04	NA	NA	NA	
Thallium	5.4E-06	NA	NA	NA	
			Pathway Total:	1.7E-08	0.0%
			Total RME ILCR:	3.8E-05	100.0%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-69. Summary of Potential Carcinogenic Risk Results for the Current Off-site Adult Resident for SWMU 7 as a Whole

Chemical	Exposure Point Concentration (mg/m^3)	Daily Carcinogenic Intake(a) (mg/kg-day)	Carcinogenic Slope Factor(b) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Inhalation of Particulates					
Aluminum	3.6E-03	NA(c)	NA	NA	
Beryllium	1.7E-07	6.3E-10	8.4E+00	5.3E-09	
Manganese	1.3E-04	NA	NA	NA	
Thallium	5.3E-06	NA	NA	NA	
			Total CTE ILCR:	5.3E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Inhalation of Particulates					
Aluminum	3.6E-03	NA	NA	NA	
Beryllium	1.7E-07	3.3E-09	8.4E+00	2.8E-08	
Manganese	1.3E-04	NA	NA	NA	
Thallium	5.3E-06	NA	NA	NA	
			Total RME ILCR:	2.8E-08	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.
[b]See Appendix M for sources and methodology of toxicity values.
[c]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-70. Summary of Potential Carcinogenic Risk Results for the Current Off-site Child Resident for SWMU 7 as a Whole

Chemical	Exposure Point Concentration (mg/m^3)	Daily Carcinogenic Intake(a) (mg/kg-day)	Carcinogenic Slope Factor(b) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Inhalation of Particulates					
Aluminum	3.6E-03	NA(d)	NA	NA	
Beryllium	1.7E-07	3.2E-09	8.4E+00	2.7E-08	
Manganese	1.3E-04	NA	NA	NA	
Thallium	5.3E-06	NA	NA	NA	
			Total CTE ILCR:	2.7E-08	100%
Reasonable Maximum Exposure (RME) Scenario					
Inhalation of Particulates					
Aluminum	3.6E-03	NA	NA	NA	
Beryllium	1.7E-07	5.2E-09	8.4E+00	4.4E-08	
Manganese	1.3E-04	NA	NA	NA	
Thallium	5.3E-06	NA	NA	NA	
			Total RME ILCR:	4.4E-08	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.
[b]See Appendix M for sources and methodology of toxicity values.
[c]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-71. Summary of Potential Systemic Effects for the Future Construction Worker for SWMU 7 (Firing Point)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Subchronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Subsurface Soil					
Arsenic	1.7E+01	9.2E-06	3.0E-04	3.1E-02	
			Pathway Total:	3.1E-02	99.6%
Dermal Contact with Subsurface Soil					
Arsenic	1.7E+01	3.3E-08	2.9E-04	1.1E-04	
			Pathway Total:	1.1E-04	0.4%
Inhalation of Particulates					
Arsenic	2.6E-04	NA(d)	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	3.1E-02	100.0%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Subsurface Soil					
Arsenic	1.7E+01	4.3E-05	3.0E-04	1.4E-01	
			Pathway Total:	1.4E-01	98.2%
Dermal Contact with Subsurface Soil					
Arsenic	1.7E+01	7.6E-07	2.9E-04	2.6E-03	
			Pathway Total:	2.6E-03	1.8%
Inhalation of Particulates					
Arsenic	2.3E-04	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	1.5E-01	100.0%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-72. Summary of Potential Systemic Effects for the Current/Future On-Site Laborer for SWMU 7 (Northwest Test Area Trench)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Aluminum	2.6E+04	6.3E-05	1.0E+00	6.3E-05	
Beryllium	1.2E+00	2.8E-09	5.0E-03	5.5E-07	
Manganese	6.0E+02	1.4E-06	1.4E-01	1.0E-05	
Thallium	3.0E+01	7.1E-08	8.0E-04	8.9E-05	
			Pathway Total:	1.6E-04	1%
Dermal Contact with Surface Soil					
Aluminum	2.6E+04	3.1E-06	2.0E-01	1.6E-05	
Beryllium	1.2E+00	1.4E-10	5.0E-06	2.8E-05	
Manganese	6.0E+02	7.2E-08	4.2E-03	1.7E-05	
Thallium	3.0E+01	3.6E-09	1.6E-04	2.2E-05	
			Pathway Total:	8.3E-05	1%
Inhalation of Particulates					
Aluminum	3.6E-03	4.1E-06	1.4E-03	2.9E-03	
Beryllium	1.8E-07	NA[d]	NA	NA	
Manganese	1.3E-04	1.5E-07	1.4E-05	1.1E-02	
Thallium	5.4E-06		NA	NA	
			Pathway Total:	1.3E-02	98%
			Total CTE HI:	1.4E-02	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Aluminum	2.6E+04	6.0E-03	1.0E+00	6.0E-03	
Beryllium	1.2E+00	2.6E-07	5.0E-03	5.3E-05	
Manganese	6.0E+02	1.4E-04	1.4E-01	9.8E-04	
Thallium	3.0E+01	6.8E-06	8.0E-05	8.6E-02	
			Pathway Total:	9.3E-02	48%
Dermal Contact with Surface Soil					
Aluminum	2.6E+04	7.0E-04	2.0E-01	3.5E-03	
Beryllium	1.2E+00	3.1E-08	5.0E-06	6.1E-03	
Manganese	6.0E+02	1.6E-05	4.2E-03	3.8E-03	
Thallium	3.0E+01	8.0E-07	1.6E-05	5.0E-02	
			Pathway Total:	6.3E-02	32%
Inhalation of Particulates					
Aluminum	3.6E-03	1.2E-05	1.4E-03	8.5E-03	
Beryllium	1.8E-07	NA	NA	NA	
Manganese	1.3E-04	4.2E-07	1.4E-05	3.0E-02	
Thallium	5.4E-06		NA	NA	
			Pathway Total:	3.9E-02	20%
			Total RME HI:	1.9E-01	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-73. Summary of Potential Systemic Effects for the Future On-Site Adult Resident for SWMU 7 (Northwest Test Area Trench)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Aluminum	2.6E+04	2.2E-03	1.0E+00	2.2E-03	
Beryllium	1.2E+00	9.5E-08	5.0E-03	1.9E-05	
Manganese	6.0E+02	4.9E-05	1.4E-01	3.5E-04	
Thallium	3.0E+01	2.5E-06	8.0E-05	3.1E-02	
			Pathway Total:	3.3E-02	7%
Dermal Contact with Surface Soil					
Aluminum	2.6E+04	1.1E-04	2.0E-01	5.4E-04	
Beryllium	1.2E+00	4.8E-09	5.0E-06	9.5E-04	
Manganese	6.0E+02	2.5E-06	4.2E-03	5.9E-04	
Thallium	3.0E+01	1.2E-07	1.6E-05	7.7E-03	
			Pathway Total:	9.8E-03	2%
Inhalation of Particulates					
Aluminum	3.6E-03	1.2E-04	1.4E-03	8.8E-02	
Beryllium	1.8E-07	NA[d]	NA	NA	
Manganese	1.3E-04	4.4E-06	1.4E-05	3.1E-01	
Thallium	5.4E-06		NA	NA	
			Pathway Total:	4.0E-01	79%
Ingestion of Leafy Vegetables					
Aluminum	7.4E+00	1.0E-03	1.0E+00	1.0E-03	
Beryllium	8.1E-04	1.1E-07	5.0E-03	2.3E-05	
Manganese	1.1E+01	1.5E-03	1.4E-01	1.1E-02	
Thallium	8.4E-03	1.2E-06	8.0E-05	1.5E-02	
			Pathway Total:	2.6E-02	5%
Ingestion of Tubers and Fruits					
Aluminum	3.8E+00	1.8E-03	1.0E+00	1.8E-03	
Beryllium	3.8E-04	1.8E-07	5.0E-03	3.6E-05	
Manganese	6.6E+00	3.1E-03	1.4E-01	2.2E-02	
Thallium	2.6E-03	1.2E-06	8.0E-05	1.5E-02	
			Pathway Total:	3.9E-02	8%
			Total CTE HI:	5.1E-01	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Aluminum	2.6E+04	1.4E-02	1.0E+00	1.4E-02	
Beryllium	1.2E+00	6.0E-07	5.0E-03	1.2E-04	
Manganese	6.0E+02	3.1E-04	1.4E-01	2.2E-03	
Thallium	3.0E+01	1.6E-05	8.0E-05	1.9E-01	
			Pathway Total:	2.1E-01	18%
Dermal Contact with Surface Soil					
Aluminum	2.6E+04	1.6E-03	2.0E-01	7.9E-03	
Beryllium	1.2E+00	7.0E-08	5.0E-06	1.4E-02	
Manganese	6.0E+02	3.6E-05	4.2E-03	8.6E-03	
Thallium	3.0E+01	1.8E-06	1.6E-05	1.1E-01	
			Pathway Total:	1.4E-01	13%
Inhalation of Particulates					
Aluminum	3.6E-03	1.7E-04	1.4E-03	1.2E-01	
Beryllium	1.8E-07	NA	NA	NA	
Manganese	1.3E-04	6.2E-06	1.4E-05	4.4E-01	
Thallium	5.4E-06		NA	NA	
			Pathway Total:	5.7E-01	49%
Ingestion of Leafy Vegetables					
Aluminum	7.4E+00	3.6E-03	1.0E+00	3.6E-03	
Beryllium	8.1E-04	4.0E-07	5.0E-03	7.9E-05	
Manganese	1.1E+01	5.2E-03	1.4E-01	3.7E-02	
Thallium	8.4E-03	4.1E-06	8.0E-05	5.1E-02	
			Pathway Total:	9.2E-02	8%
Ingestion of Tubers and Fruits					
Aluminum	3.8E+00	6.2E-03	1.0E+00	6.2E-03	
Beryllium	3.8E-04	6.3E-07	5.0E-03	1.3E-04	
Manganese	6.6E+00	1.1E-02	1.4E-01	7.8E-02	
Thallium	2.6E-03	4.3E-06	8.0E-05	5.4E-02	
			Pathway Total:	1.4E-01	12%
			Total RME HI:	1.2E+00	100%

[a] Units for the inhalation pathway are mg/m^3.
[b] See Appendix L for sources and methodology on estimating a daily intake value.
[c] See Appendix M for sources and methodology of toxicity values.
[d] NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-74. Summary of Potential Systemic Effects for the Future On-Site Child Resident for SWMU 7 (Northwest Test Area Trench)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Aluminum	2.6E+04	9.8E-03	1.0E+00	9.8E-03	
Beryllium	1.2E+00	4.3E-07	5.0E-03	8.6E-05	
Manganese	6.0E+02	2.2E-04	1.4E-01	1.6E-03	
Thallium	3.0E+01	1.1E-05	8.0E-05	1.4E-01	
			Pathway Total:	1.5E-01	6.5%
Dermal Contact with Surface Soil					
Aluminum	2.6E+04	1.9E-05	2.0E-01	9.7E-05	
Beryllium	1.2E+00	8.6E-10	5.0E-06	1.7E-04	
Manganese	6.0E+02	4.4E-07	4.2E-03	1.1E-04	
Thallium	3.0E+01	2.2E-08	1.6E-05	1.4E-03	
			Pathway Total:	1.8E-03	0.1%
Inhalation of Particulates					
Aluminum	3.6E-03	6.3E-04	1.4E-03	4.5E-01	
Beryllium	1.8E-07	NA[d]	NA	NA	
Manganese	1.3E-04	2.2E-05	1.4E-05	1.6E+00	
Thallium	5.4E-06		NA	NA	
			Pathway Total:	2.1E+00	88.8%
Ingestion of Leafy Vegetables					
Aluminum	7.4E+00	1.7E-03	1.0E+00	1.7E-03	
Beryllium	8.1E-04	1.8E-07	5.0E-03	3.7E-05	
Manganese	1.1E+01	2.4E-03	1.4E-01	1.7E-02	
Thallium	8.4E-03	1.9E-06	8.0E-05	2.4E-02	
			Pathway Total:	4.3E-02	1.8%
Ingestion of Tubers and Fruits					
Aluminum	3.8E+00	2.9E-03	1.0E+00	2.9E-03	
Beryllium	3.8E-04	2.9E-07	5.0E-03	5.8E-05	
Manganese	6.6E+00	5.1E-03	1.4E-01	3.6E-02	
Thallium	2.6E-03	2.0E-06	8.0E-05	2.5E-02	
			Pathway Total:	6.4E-02	2.8%
			Total CTE HI:	2.3E+00	100.0%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Aluminum	2.6E+04	4.9E-02	1.0E+00	4.9E-02	
Beryllium	1.2E+00	2.1E-06	5.0E-03	4.3E-04	
Manganese	6.0E+02	1.1E-03	1.4E-01	7.9E-03	
Thallium	3.0E+01	5.6E-05	8.0E-05	6.9E-01	
			Pathway Total:	7.5E-01	29.0%
Dermal Contact with Surface Soil					
Aluminum	2.6E+04	1.1E-03	2.0E-01	5.5E-03	
Beryllium	1.2E+00	4.9E-08	5.0E-06	9.8E-03	
Manganese	6.0E+02	2.5E-05	4.2E-03	6.0E-03	
Thallium	3.0E+01	1.3E-06	1.6E-05	7.9E-02	
			Pathway Total:	1.0E-01	3.9%
Inhalation of Particulates					
Aluminum	3.6E-03	4.5E-04	1.4E-03	3.2E-01	
Beryllium	1.8E-07	NA	NA	NA	
Manganese	1.3E-04	1.6E-05	1.4E-05	1.2E+00	
Thallium	5.4E-06		NA	NA	
			Pathway Total:	1.5E+00	57.4%
Ingestion of Leafy Vegetables					
Aluminum	7.4E+00	3.9E-03	1.0E+00	3.9E-03	
Beryllium	8.1E-04	4.3E-07	5.0E-03	8.7E-05	
Manganese	1.1E+01	5.6E-03	1.4E-01	4.0E-02	
Thallium	8.4E-03	4.5E-06	8.0E-05	5.6E-02	
			Pathway Total:	1.0E-01	3.9%
Ingestion of Tubers and Fruits					
Aluminum	3.8E+00	6.8E-03	1.0E+00	6.8E-03	
Beryllium	3.8E-04	6.8E-07	5.0E-03	1.4E-04	
Manganese	6.6E+00	1.2E-02	1.4E-01	8.5E-02	
Thallium	2.6E-03	4.7E-06	8.0E-05	5.9E-02	
			Pathway Total:	1.5E-01	5.8%
			Total RME HI:	2.6E+00	100.0%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-75. Summary of Potential Systemic Effects for the Future Construction Worker for SWMU 7 (Northwest Test Area Trench)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Subchronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Aluminum	4.2E+04	2.3E-02	1.0E+00	2.3E-02	
Beryllium	1.8E+00	9.8E-07	5.0E-03	2.0E-04	
Thallium	4.1E+01	2.3E-05	8.0E-04	2.8E-02	
			Pathway Total:	5.2E-02	2%
Dermal Contact with Surface Soil					
Aluminum	4.2E+04	8.3E-05	2.0E-01	4.1E-04	
Beryllium	1.8E+00	3.5E-09	5.0E-06	7.0E-04	
Thallium	4.1E+01	8.0E-08	1.6E-04	5.0E-04	
			Pathway Total:	1.6E-03	0%
Inhalation of Particulates					
Aluminum	5.8E-01	4.2E-03	1.4E-03	3.0E+00	
Beryllium	2.4E-05	NA(d)	NA	NA	
Thallium	5.6E-04	NA	NA	NA	
			Pathway Total:	3.0E+00	98%
			Total CTE HI:	3.1E+00	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Aluminum	4.2E+04	1.1E-01	1.0E+00	1.1E-01	
Beryllium	1.8E+00	4.6E-06	5.0E-03	9.2E-04	
Thallium	4.1E+01	1.1E-04	8.0E-04	1.3E-01	
			Pathway Total:	2.4E-01	2%
Dermal Contact with Surface Soil					
Aluminum	4.2E+04	1.9E-03	2.0E-01	9.6E-03	
Beryllium	1.8E+00	8.1E-08	5.0E-06	1.6E-02	
Thallium	4.1E+01	1.9E-06	1.6E-04	1.2E-02	
			Pathway Total:	3.7E-02	0%
Inhalation of Particulates					
Aluminum	5.8E-01	1.8E-02	1.4E-03	1.3E+01	
Beryllium	2.4E-05	NA	NA	NA	
Thallium	5.6E-04	NA	NA	NA	
			Pathway Total:	1.3E+01	98%
			Total RME HI:	1.3E+01	100%

[a] Units for the inhalation pathway are mg/m^3.

[b] See Appendix L for sources and methodology on estimating a daily intake value.

[c] See Appendix M for sources and methodology of toxicity values.

[d] NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-76. Summary of Potential Systemic Effects for the Current/Future On-Site Laborer for SWMU 7 (Bullet Stop)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Thallium	2.1E+01	5.0E-08	8.0E-04	6.2E-05	
			Pathway Total:	6.2E-05	0.5%
Dermal Contact with Surface Soil					
Thallium	2.1E+01	2.5E-09	1.6E-04	1.5E-05	
			Pathway Total:	1.5E-05	0.1%
Inhalation of Particulates					
Aluminum	3.6E-03	4.1E-06	1.4E-03	2.9E-03	
Beryllium	1.8E-07	NA(d)	NA	NA	
Manganese	1.3E-04	1.5E-07	1.4E-05	1.1E-02	
Thallium	5.4E-06	NA	NA	NA	
			Pathway Total:	1.3E-02	99.4%
			Total CTE HI:	1.4E-02	100.0%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Thallium	2.1E+01	4.7E-06	8.0E-05	5.9E-02	
			Pathway Total:	5.9E-02	12.3%
Dermal Contact with Surface Soil					
Thallium	2.1E+01	5.5E-07	1.6E-05	3.4E-02	
			Pathway Total:	3.4E-02	7.2%
Inhalation of Particulates					
Aluminum	3.6E-03	1.2E-04	1.4E-03	8.5E-02	
Beryllium	1.8E-07	NA	NA	NA	
Manganese	1.3E-04	4.2E-06	1.4E-05	3.0E-01	
Thallium	5.4E-06	NA	NA	NA	
			Pathway Total:	3.9E-01	80.5%
			Total RME HI:	4.8E-01	100.0%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-77. Summary of Potential Systemic Effects for the Future On-Site Adult Resident for SWMU 7 (Bullet Stop)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Thallium	2.1E+01	1.7E-06	8.0E-05	2.1E-02	
			Pathway Total:	2.1E-02	5%
Dermal Contact with Surface Soil					
Thallium	2.1E+01	8.5E-08	1.6E-05	5.3E-03	
			Pathway Total:	5.3E-03	1%
Inhalation of Particulates					
Aluminum	3.6E-03	1.2E-04	1.4E-03	8.8E-02	
Beryllium	1.8E-07	NA[d]	NA	NA	
Manganese	1.3E-04	4.4E-06	1.4E-05	3.1E-01	
Thallium	5.4E-06	NA	NA	NA	
			Pathway Total:	4.0E-01	89%
Ingestion of Leafy Vegetables					
Thallium	5.8E-03	8.1E-07	8.0E-05	1.0E-02	
			Pathway Total:	1.0E-02	2%
Ingestion of Tubers and Fruits					
Thallium	1.8E-03	8.5E-07	8.0E-05	1.1E-02	
			Pathway Total:	1.1E-02	2%
			Total CTE HI:	4.5E-01	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Thallium	2.1E+01	1.1E-05	8.0E-05	1.3E-01	
			Pathway Total:	1.3E-01	16%
Dermal Contact with Surface Soil					
Thallium	2.1E+01	1.3E-06	1.6E-05	7.9E-02	
			Pathway Total:	7.9E-02	9%
Inhalation of Particulates					
Aluminum	3.6E-03	1.7E-04	1.4E-03	1.2E-01	
Beryllium	1.8E-07	NA	NA	NA	
Manganese	1.3E-04	6.2E-06	1.4E-05	4.4E-01	
Thallium	5.4E-06	NA	NA	NA	
			Pathway Total:	5.7E-01	66%
Ingestion of Leafy Vegetables					
Thallium	5.8E-03	2.8E-06	8.0E-05	3.6E-02	
			Pathway Total:	3.6E-02	4%
Ingestion of Tubers and Fruits					
Thallium	1.8E-03	3.0E-06	8.0E-05	3.7E-02	
			Pathway Total:	3.7E-02	4%
			Total RME HI:	8.5E-01	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-78. Summary of Potential Systemic Effects for the Future On-Site Child Resident for SWMU 7 (Bullet Stop)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Thallium	2.1E+01	7.7E-06	8.0E-05	9.7E-02	
			Pathway Total:	9.7E-02	4.4%
Dermal Contact with Surface Soil					
Thallium	2.1E+01	1.5E-08	1.6E-05	9.6E-04	
			Pathway Total:	9.6E-04	0.04%
Inhalation of Particulates					
Aluminum	3.6E-03	6.3E-04	1.4E-03	4.5E-01	
Beryllium	1.8E-07	NA[d]	NA	NA	
Manganese	1.3E-04	2.2E-05	1.4E-05	1.6E+00	
Thallium	5.4E-06	NA	NA	NA	
			Pathway Total:	2.1E+00	94.0%
Ingestion of Leafy Vegetables					
Thallium	5.8E-03	1.3E-06	8.0E-05	1.6E-02	
			Pathway Total:	1.6E-02	0.8%
Ingestion of Tubers and Fruits					
Thallium	1.8E-03	1.4E-06	8.0E-05	1.7E-02	
			Pathway Total:	1.7E-02	0.8%
			Total CTE HI:	2.2E+00	100.0%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Thallium	2.1E+01	3.8E-05	8.0E-05	4.8E-01	
			Pathway Total:	4.8E-01	22.9%
Dermal Contact with Surface Soil					
Thallium	2.1E+01	8.8E-07	1.6E-05	5.5E-02	
			Pathway Total:	5.5E-02	2.6%
Inhalation of Particulates					
Aluminum	3.6E-03	4.5E-04	1.4E-03	3.2E-01	
Beryllium	1.8E-07	NA	NA	NA	
Manganese	1.3E-04	1.6E-05	1.4E-05	1.2E+00	
Thallium	5.4E-06	NA	NA	NA	
			Pathway Total:	1.5E+00	70.7%
Ingestion of Leafy Vegetables					
Thallium	5.8E-03	3.1E-06	8.0E-05	3.9E-02	
			Pathway Total:	3.9E-02	1.8%
Ingestion of Tubers and Fruits					
Thallium	1.8E-03	3.2E-06	8.0E-05	4.1E-02	
			Pathway Total:	4.1E-02	1.9%
			Total RME HI:	2.1E+00	100.0%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-79. Summary of Potential Systemic Effects for the Future Construction Worker for SWMU 7 (Bullet Stop)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Subchronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.8E+01	9.6E-06	3.0E-04	3.2E-02	
Zinc	9.9E+03	5.4E-03	3.0E-01	1.8E-02	
			Pathway Total:	5.0E-02	99.5%
Dermal Contact with Surface Soil					
Arsenic	1.8E+01	3.4E-08	2.9E-04	1.2E-04	
Zinc	9.9E+03	1.9E-05	1.5E-01	1.3E-04	
			Pathway Total:	2.5E-04	0.5%
Inhalation of Particulates					
Arsenic	2.4E-04	NA	NA	NA	
Zinc	1.3E-01	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	5.0E-02	100.0%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.8E+01	4.5E-05	3.0E-04	1.5E-01	
Zinc	9.9E+03	2.5E-02	3.0E-01	8.4E-02	
			Pathway Total:	2.3E-01	97.6%
Dermal Contact with Surface Soil					
Arsenic	1.8E+01	8.0E-07	2.9E-04	2.7E-03	
Zinc	9.9E+03	4.5E-04	1.5E-01	3.0E-03	
			Pathway Total:	5.7E-03	2.4%
Inhalation of Particulates					
Arsenic	2.4E-04	NA	NA	NA	
Zinc	1.3E-01	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	2.4E-01	100.0%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-80. Summary of Potential Systemic Effects for the Current/Future On-site Laborer for SWMU 7 as a Whole

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Aluminum	2.1E+04	4.9E-05	1.0E+00	4.9E-05	
Beryllium	1.0E+00	2.4E-09	5.0E-03	4.8E-07	
Manganese	7.3E+02	1.7E-06	1.4E-01	1.2E-05	
Thallium	3.1E+01	7.3E-08	8.0E-.04	9.2E-05	
			Pathway Total:	1.5E-04	1%
Dermal Contact with Surface Soil					
Aluminum	2.1E+04	2.4E-06	2.0E-01	1.2E-05	
Beryllium	1.0E+00	1.2E-10	5.0E-06	2.4E-05	
Manganese	7.3E+02	8.7E-08	4.2E-03	2.1E-05	
Thallium	3.1E+01	3.7E-09	1.6E-04	2.3E-05	
			Pathway Total:	8.0E-05	1%
Inhalation of Particulates					
Aluminum	3.6E-03	4.1E-06	1.4E-03	2.9E-03	
Beryllium	1.8E-07	NA[d]	NA	NA	
Manganese	1.3E-04	1.5E-07	1.4E-05	1.1E-02	
Thallium	5.4E-06	NA	NA	NA	
			Pathway Total:	1.4E-02	98%
			Total CTE HI:	1.4E-02	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Aluminum	2.1E+04	4.7E-03	1.0E+00	4.7E-03	
Beryllium	1.0E+00	2.3E-07	5.0E-03	4.6E-05	
Manganese	7.3E+02	1.7E-04	1.4E-01	1.2E-03	
Thallium	3.1E+01	7.0E-06	8.0E-05	8.8E-02	
			Pathway Total:	9.4E-02	48%
Dermal Contact with Surface Soil					
Aluminum	2.1E+04	5.4E-04	2.0E-01	2.7E-03	
Beryllium	1.0E+00	2.7E-08	5.0E-06	5.3E-03	
Manganese	7.3E+02	1.9E-05	4.2E-03	4.6E-03	
Thallium	3.1E+01	8.2E-07	1.6E-05	5.1E-02	
			Pathway Total:	6.4E-02	32%
Inhalation of Particulates					
Aluminum	3.6E-03	1.2E-05	1.4E-03	8.5E-03	
Beryllium	1.8E-07	NA	NA	NA	
Manganese	1.3E-04	4.3E-07	1.4E-05	3.1E-02	
Thallium	5.4E-06	NA	NA	NA	
			Pathway Total:	3.9E-02	20%
			Total RME HI:	2.0E-01	100%

aUnits for the inhalation pathway are mg/m^3.
bSee Appendix L for sources and methodology on estimating a daily intake value.
cSee Appendix M for sources and methodology of toxicity values.
dNA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-81. Summary of Potential Systemic Effects for the Current Off-site Adult Resident for SWMU 7 as a Whole

Chemical	Exposure Point Concentration (mg/m^3)	Daily Noncarcinogenic Intake[(a)] (mg/kg-day)	Chronic RfD[(b)] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Inhalation of Particulates					
Aluminum	3.6E-03	1.2E-04	1.4E-03	8.6E-02	
Beryllium	1.7E-07	NA[(c)]	NA	NA	
Manganese	1.3E-04	4.3E-06	1.4E-05	3.1E-01	
Thallium	5.3E-06	NA	NA	NA	
			Total CTE HI:	3.9E-01	100%
Reasonable Maximum Exposure (RME) Scenario					
Inhalation of Particulates					
Aluminum	3.6E-03	1.7E-04	1.4E-03	1.2E-01	
Beryllium	1.7E-07	NA	NA	NA	
Manganese	1.3E-04	6.0E-06	1.4E-05	4.3E-01	
Thallium	5.3E-06	NA	NA	NA	
			Total RME HI:	5.5E-01	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.
[b]See Appendix M for sources and methodology of toxicity values.
[c]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-82. Summary of Potential Systemic Effects for the Current Off-site Child Resident for SWMU 7 as a Whole

Chemical	Exposure Point Concentration (mg/m^3)	Daily Noncarcinogenic Intake[(a)] (mg/kg-day)	Chronic RfD[(b)] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Inhalation of Particulates					
Aluminum	3.6E-03	6.2E-04	1.4E-03	4.4E-01	
Beryllium	1.7E-07	NA[(c)]	NA	NA	
Manganese	1.3E-04	2.2E-05	1.4E-05	1.6E+00	
Thallium	5.3E-06	NA	NA	NA	
			Total CTE HI:	2.0E+00	100%
Reasonable Maximum Exposure (RME) Scenario					
Inhalation of Particulates					
Aluminum	3.6E-03	4.5E-04	1.4E-03	3.2E-01	
Beryllium	1.7E-07	NA	NA	NA	
Manganese	1.3E-04	1.6E-05	1.4E-05	1.1E+00	
Thallium	5.3E-06	NA	NA	NA	
			Total RME HI:	1.5E+00	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.
[b]See Appendix M for sources and methodology of toxicity values.
[c]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

5.2.4.5.1 *Characterization of Potential Carcinogenic Risks*

Firing Point Area of Concern. The general process used to select the COPCs associated with the Firing Point Area of Concern is described in Section 3.1.1. COPC selection for SWMU 7 is described in Section 5.2.4.2. For future land use scenarios, arsenic, a confirmed human carcinogen, is the only COPC identified.

Future Construction Worker. The cumulative ILCR from potential exposure to arsenic for all pathways are 6.9E-06 and 5.1E-07 for the RME and CTE scenarios, respectively. As summarized In Table 5-59, the driving pathway is inhalation of particulates generated from subsurface soil, which contributes greater than 63 percent of the estimated risk. Arsenic is the sole contributor to this risk estimate.

Arsenic is the sole COPC in subsurface soils within the Firing Point Area of concern. The total ILCR for inhalation of particulates generated from subsurface soil by workers at the Firing Point Area of Concern for SWMU 7 is 4.3E-06 and 3.3E-07 for the RME and CTE scenarios, respectively. For ingestion of subsurface soil by workers, the total ILCR ranges from 2.6E-06 and 1.8E-07 for the RME and CTE scenarios, respectively. Dermal contact with subsurface soil by workers does not present an individual risk above the lower bound of the target risk range.

Northwest Test Area Trench Area of Concern. The general process used to select the COPCs associated with the Northwest Test Area Trench Area of Concern is described in Section 3.1.1. COPC selection for SWMU 7 is described in Section 5.2.4.2. For current and future land use scenarios, aluminum, beryllium, manganese, and thallium were identified as COPCs. Beryllium, a suspected human carcinogen, is the only COPC which contributes to the carcinogenic risk. Tables 5-54 and 5-55 list the COPCs and their associated media.

Current/Future On-site Laborer. The cumulative ILCR for all pathways are 4.5E-05 and 2.4E-08 for the RME and CTE scenarios, respectively. As summarized in Table 5-60, the driving pathway is dermal contact with surface soil, which contributes greater than 98 percent of the estimated risk. Beryllium is the sole contributor to this risk estimate.

A major factor in the risk analysis is the method proposed by USEPA (1989a) for estimation of a dermal slope factor based on oral absorption. Nonlipophilic chemicals (e.g., inorganic salts) are poorly absorbed (USEPA 1992c) and seldom present significant risk via this route of exposure. Dermal exposure assessment guidance (USEPA 1992c) does not include quantitative evaluation of this pathway for metals. As a result, this estimate for dermal absorption risk from beryllium, as well as those for other inorganics in this risk assessment, is likely an overestimate.

If, based on the above references, dermal contact with soils containing these metals is assumed to present negligible risk, the cumulative ILCR for the remaining pathways are negligible with values ranging from 4.7E-10 to 3.8E-7.

Future On-site Adult Resident. The cumulative ILCR for all pathways is 1.2E-04 and 2.4E-06 for the RME and CTE scenarios, respectively. As summarized in Table 5-61, the driving pathway is dermal contact with surface soil, which contributes greater than 92 percent of the estimated risk. The sole contributor to this risk estimate is beryllium.

A major factor in the risk analysis is the method proposed by USEPA (1989a) for estimation of a dermal slope factor based on oral absorption. Nonlipophilic chemicals (e.g., inorganic salts) are poorly absorbed (USEPA 1992c) and seldom present significant risk via this route of exposure. Dermal exposure assessment guidance (USEPA 1992c) does not include quantitative evaluation of this pathway for inorganics. As a result, this estimate for dermal absorption risk from beryllium, as well as those for other metals in this risk assessment, is likely an overestimate.

If, based on the above discussion, dermal contact with soils containing these inorganics is assumed to present negligible risk, the cumulative ILCRs for the remaining pathways are also negligible. Ingestion of surface soil and produce have ILCRs that range from slightly above to well below the lower bound of the target risk range, with values ranging from 1.8E-06 to 4.4E-08. Inhalation of particulates by adult residents does not present an individual risk above the lower bound of the target risk range. Beryllium is the only contributor to these risk estimates.

Future On-site Child Resident. The cumulative ILCR for all pathways is 5.4E-05 and 4.1E-06 for the RME and CTE scenarios, respectively. As summarized in Table 5-62, the driving pathway is dermal contact with surface soil, which contributes greater than 89 percent of the estimated risk. Beryllium is the sole contributor to the risk estimates.

A major factor in the risk analysis is the method proposed by USEPA (1989a) for estimation of a dermal slope factor based on oral absorption. Nonlipophilic chemicals (e.g., inorganic salts) are poorly absorbed (USEPA 1992c) and seldom present significant risk via this route of exposure. Dermal exposure assessment guidance (USEPA 1992c) does not include quantitative evaluation of this pathway for metals. As a result, this estimate for dermal absorption risk from beryllium is likely an overestimate.

If, based on the above references, dermal contact with soils containing these inorganics is assumed to present negligible risks, the cumulative ILCRs for the remaining pathways are also negligible. The total ILCR for dermal contact with surface soil by child residents at the Northwest Test Area Trench area of concern for SWMU 7 is 5.0E-05 and 3.7E-06 for the RME and CTE scenarios, respectively. Ingestion of surface soil and produce have ILCRs that range from slightly above to well below the lower bound of the target risk range, ranging from 2.2E-06 to 2.0E-07. Inhalation of particulates by child residents does not present an individual risk above the lower bound of the target risk range. Beryllium is the sole contributor to these risk estimates.

Future Construction Worker. The cumulative ILCR for all pathways is 1.5E-05 and 2.8E-07 for the RME and CTE scenarios, respectively. As summarized in Table 5-63, the driving

pathway is dermal contact with subsurface soil, which contributes greater than 72 percent of the estimated risk. Beryllium is the sole contributor to these risk estimates.

A major factor in the risk analysis is the method proposed by USEPA (1989a) for estimation of a dermal slope factor based on oral absorption. Nonlipophilic chemicals (e.g., inorganic salts) are poorly absorbed (USEPA 1992c) and seldom present significant risk via this route of exposure. Dermal exposure assessment guidance (USEPA 1992c) does not include quantitative evaluation of this pathway for metals. As a result, this estimate for dermal absorption risk from beryllium is likely an overestimate.

If, based on the above references, dermal contact with soils containing these inorganics is assumed to present negligible risks, the ILCR for the remaining pathways also are negligible. The total ILCR for dermal contact with subsurface soil by workers at the Northwest Test Area Trench Area of Concern for SWMU 7 is 1.4E-05 and 2.0E-07 for the RME and CTE scenarios, respectively. Ingestion of subsurface soil and inhalation of particulates by workers does not present an individual risk above the lower bound of the target risk range. The estimated ILCRs for these pathways range from 7.9E-07 to 2.0E-08. Beryllium is the only contributor to the estimated risk.

Bullet Stop Area of Concern. The process used to select the COPCs associated with the Bullet Stop Area of Concern is described in Section 3.1.1. COPC selection for SWMU 7 is discussed in Section 5.2.4.2. For current land use scenarios for adult receptors and future land use scenarios for children, aluminum, beryllium, manganese, and thallium were identified as the COPCs. Beryllium, a suspected human carcinogen, is the only COPC that contributes to the carcinogenic risk for these scenarios. Additionally, arsenic and zinc were identified as COPCs in subsurface soil and associated air emissions for the future industrial use-adult (construction worker) scenario.

Arsenic, a confirmed human carcinogen, is the only contributor to the risks estimated for this scenario. Tables 5-56 and 5-57 list these COPCs and their associated media.

Current/Future On-site Laborer. As summarized in Table 5-64, the cumulative ILCR for all pathways does not exceed the lower limit of the target risk range. The total ILCR is 1.6E-08 and 6.8E-11 for the RME and CTE scenarios, respectively. Beryllium is the sole contributor to the risk estimate. Inhalation of particulates is the only pathway evaluated because no carcinogens were identified as a COPC (Section 5.2.4.2) for other pathways used in this exposure scenario.

Future On-site Adult Resident. As summarized in Table 5-65, the cumulative ILCR for all pathways does not exceed the lower limit of the target risk range. The total ILCR is 2.8E-08 and 5.4E-09 for the RME and CTE scenarios, respectively. Beryllium is the sole contributor to the risk estimates. Inhalation of particulates is the only pathway evaluated because no carcinogens were identified as a COPC (5.2.4.2) for other pathways used in this exposure scenario.

Future On-site Child Resident. As summarized in Table 5-66, the cumulative ILCR for all pathways does not exceed the lower limit of the target risk range. The total ILCR is 4.5E-08 and 2.7E-08 for the RME and CTE scenarios, respectively. Beryllium is the sole contributor to the risk estimates. Inhalation of particulates is the only pathway evaluated because no carcinogens were identified as a COPC (Section 5.2.4.2) for other pathways used in this exposure scenario.

Future Construction Worker. The cumulative ILCR for all pathways is 7.3E-06 and 5.4E-07 for the RME and CTE scenarios, respectively. As summarized in Table 5-67, the driving pathway is inhalation of particulates generated from subsurface soil, which contributes greater than 63 percent of the estimated risk. Arsenic is the sole contributor to these risk estimates.

The total ILCR for inhalation of particulates by workers at the Bullet Stop area of concern for SWMU 7 is 4.6E-06 and 3.5E-07 for the RME and CTE scenarios, respectively. For ingestion of subsurface soil pathway, the total ILCR ranges from 2.7E-06 and 1.9E-07 for the RME and CTE scenarios, respectively. Dermal contact with subsurface soil by workers does not present an individual risk above the lower bound of the target risk range. Arsenic is the only contributor to the estimated risk because no other carcinogens were identified as a COPC (Section 5.2.4.2) for the pathways evaluated.

<u>SWMU 7 as a Whole</u>. The process used to identify COPCs for SWMU 7 as a whole is discussed in Section 3.1.1. COPC selection for SWMU 7 is discussed in Section 5.2.4.2. For current land use scenarios, aluminum, beryllium, manganese, and thallium were identified as COPCs. Beryllium, a suspected human carcinogen, is the sole contributor to the risk estimates for this area. Table 5-58 lists these COPCs and their associated media.

Current/Future On-site Laborer. The cumulative ILCR for all pathways is 3.8E-05 and 2.1E-08 for the RME and CTE scenarios, respectively. As summarized in Table 5-68, the driving pathway is dermal contact with surface soil, which contributes greater than 98 percent of the estimated risk. Beryllium is the sole contributor to these risk estimates.

A major factor in the risk analysis is the method proposed by USEPA (1989a) for estimation of a dermal slope factor based on oral absorption. Nonlipophilic chemicals (e.g., inorganic salts) are poorly absorbed (USEPA 1992c) and seldom present significant risk via this route of exposure. Dermal exposure assessment guidance (USEPA 1992c) does not include quantitative evaluation of this pathway for metals. As a result, this estimate for dermal absorption risk from beryllium, as well as those for other metals in this risk assessment, is likely an overestimate.

The total ILCR for dermal contact with surface soil by laborers is 3.8E-05 and 2.0E-08 for the RME and CTE scenarios, respectively. Ingestion of surface soil and inhalation of particulates by laborers does not present an individual risk above the lower bound of the target risk range. The estimated ILCRs for these pathways range from 3.3E-07 to 6.9E-11. Beryllium is the only contributor to the estimated risk. No other carcinogens were identified for the pathways and media evaluated.

Current Off-site Adult Resident. The cumulative ILCR for the inhalation pathway does not exceed the lower bound limit of the target risk range. The total ILCR is 2.8E-08 and 5.3E-09 for the RME and CTE scenarios, respectively, as summarized in Table 5-69. The sole contributor to these risk estimates is beryllium.

Current Off-site Child Resident. The cumulative ILCR for the inhalation pathway does not exceed the lower bound limit of the target risk range. The total ILCR is 4.4E-08 and 2.7E-08 for the RME and CTE scenarios, respectively, as summarized in Table 5-70. The sole contributor to these risk estimates is beryllium.

5.2.4.5.2 *Characterization of Potential Systemic Effects*

<u>Firing Point Area of Concern</u>

Future Construction Worker. As summarized in Table 5-71, the summed HI for all pathways does not exceed unity and ranges from 1.5E-01 to 3.1E-02 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of subsurface soil, which contributes greater than 98 percent of the total HI. The sole contributor to these risk estimates is arsenic.

<u>Northwest Test Area Trench Area of Concern</u>. The COPCs identified for the Northwest Test Area Trench area of concern are aluminum, beryllium, manganese, and thallium. All four COPCs were evaluated for potential systemic effects. Tables 5-72 through Table 5-75 provide a summary of these potential effects.

Current/Future On-site Laborer. As summarized in Table 5-72, the summed HI for all pathways does not exceed unity (one). The total HIs for all pathways range from 1.9E-01 and 1.4E-02 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of surface soil (48 percent) for the RME scenario, and the greatest contributors to the risk estimate are thallium and aluminum. For the CTE scenario, the inhalation of particulates is the driving pathway (98 percent), and the greatest contributors to the risk estimate are aluminum and manganese.

Future On-site Adult Resident. As summarized in Table 5-73, the summed HI for all pathways ranges from 1.2E+00 to 5.1E-01 for the RME and CTE scenarios, respectively. The driving pathway is inhalation of particulates, which contributes greater than 49 percent of the total HI for the RME scenario. Aluminum and manganese are the only contributors to the inhalation of particulates HI. Inhalation reference doses for beryllium and thallium were not available at the time of this report. Therefore, beryllium and thallium were not evaluated for the inhalation pathway.

The total HI for inhalation of particulates by adult residents is below unity (one) and ranges from 5.7E-01 and 4.0E-01 for the RME and CTE scenarios, respectively. The HIs for the remaining pathways evaluated are below unity (one) and range from 2.3E-01 to 9.8E-03.

Future On-site Child Resident. As summarized in Table 5-74, the summed HI for all pathways ranges from 2.6E+00 to 2.3E+00 for the RME and CTE scenarios, respectively. The driving pathway for the RME scenario is inhalation of particulates, which contributes greater than 57 percent of the total HI. The only contributors to the inhalation pathway HI are aluminum and manganese. Inhalation reference doses for beryllium and thallium were not available at the time of this report. Therefore, beryllium and thallium were not evaluated for the inhalation pathway.

The total HI for inhalation of particulates by child residents is 1.5E+00 and 2.1E+00 for the RME and CTE scenarios, respectively. As stated above, aluminum and manganese are the only contributors to the HI estimates for the inhalation of particulates for both the RME and CTE scenarios. For the ingestion of surface soil pathway, the total HI is below unity (one) and ranges from 7.5E-01 to 1.5E-01 for the RME and CTE scenarios, respectively. The HIs for the remaining pathways evaluated are below unity (one) and range from 2.5E-01 to 1.8E-03.

Future Construction Worker. As summarized in Table 5-75, the summed HI for all pathways ranges from 1.3E+01 to 3.1E+00 for the RME and CTE scenarios, respectively. The driving pathway for the RME scenario is inhalation of particulates, which contributes greater than 98 percent of the total HI. The only contributor to the inhalation pathway HI is aluminum. Inhalation reference doses for beryllium and thallium were not available at the time of this report. Therefore, beryllium and thallium were not evaluated for the inhalation pathway.

The total HI for inhalation of particulates by the future construction worker is 1.3E+01 and 3.0E+00 for the RME and CTE scenarios, respectively. As stated above, aluminum is the only contributor to the HI estimates for the inhalation of particulates for both the RME and CTE scenarios. The HIs for the remaining pathways evaluated are below unity (one) and range from 2.4E-01 to 1.6E-03.

Bullet Stop Area of Concern. The COPCs identified for the Bullet Stop area of concern are arsenic, aluminum, beryllium, manganese, thallium, and zinc. All COPCs were evaluated for potential systemic effects. These effects are summarized in Tables 5-76 through 5-79.

Current/Future On-site Laborer. As summarized in Table 5-76, the summed HI for all pathways does not exceed unity (one). The total HIs for all pathways range from 4.8E-01 and 1.4E-02 for the RME and CTE scenarios, respectively. The driving pathway is inhalation of particulates, which contributes greater than 80 percent of the total HI.

Future On-site Adult Resident. As summarized in Table 5-77, the summed HI for all pathways does not exceed unity (one). The total HIs for all pathways range from 8.5E-01 to 4.5E-01 for the RME and CTE scenarios, respectively. The driving pathway is inhalation of particulates, which contributes greater than 66 percent of the total HI.

The total HI for inhalation of particulates by adult residents is 5.7E-01 and 4.0E-01 for the RME and CTE scenarios, respectively. The HIs for the remaining pathways evaluated are below unity (one) and range from 1.3E-01 to 5.3E-03.

Future On-site Child Resident. As summarized in Table 5-78, the summed HI for all pathways ranges from 2.1E+00 to 2.2E+00 for the RME and CTE scenarios, respectively. The driving pathway is inhalation of particulates, which contributes greater than 70 percent of the total HI for the RME scenario. Aluminum and manganese are the only contributors to the inhalation of particulates pathway HI. Inhalation reference doses for beryllium and thallium were not available at the time of this report. Therefore, beryllium and thallium could not be evaluated for this pathway.

The total HI for inhalation of particulates by child residents is 1.5E+00 and 2.1E+00 for the RME and CTE scenarios, respectively. As stated above, the only contributors to these HIs are aluminum and manganese. For the ingestion of surface soil pathway, the total HI ranges from 4.8E-01 to 9.7E-02 for the RME and CTE scenarios, respectively. The HIs for the remaining pathways evaluated are below unity (one) and range from 8.0E-02 to 9.6E-04.

Future Construction Worker. As summarized in Table 5-79, the summed HI for all pathways does not exceed unity (one). The total HIs for all pathways range from 2.4E-01 and 5.0E-02 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of subsurface soil, which contributes greater than 98 percent of the total HI.

<u>SWMU 7 as a Whole</u>. The COPCs identified for SWMU 7 as a whole are aluminum, beryllium, manganese, and thallium. All four COPCs were evaluated for potential systemic effects. Tables 5-80 through 5-82 provide a summary of these potential effects.

Current/Future On-site Laborer. As summarized in Table 5-80, the summed HI for all pathways does not exceed unity (one). The total HIs for all pathways range from 2.0E-01 and 1.5E-02 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of soil (48 percent) for the RME scenario and inhalation of particulates (98 percent) for the CTE scenario.

Current Off-site Adult Resident. As summarized in Table 5-81, the HI for the inhalation of particulates pathway does not exceed unity (one). The total HIs for the inhalation pathway ranges from 5.5E-01 to 3.9E-01 for the RME and CTE scenarios, respectively.

Current Off-site Child Resident. As summarized in Table 5-82, the summed HI for the inhalation pathway for the child resident at the SWMU boundary ranges from 1.5E+00 to 2.0E+00 for the RME and CTE scenarios, respectively. The only contributors to the HI are aluminum and manganese. The driving COPC is manganese, which contributes greater than 73 percent of the total HI. Inhalation reference doses for beryllium and thallium were not available at the time of this report. Therefore, beryllium and thallium could not be evaluated for the inhalation pathway.

5.2.4.6 *Risk Assessment Summary and Conclusions*

A baseline risk assessment was conducted for the Chemical Range (SWMU 7) based on Phase I and Phase II RI data. Four current and future land use scenarios were quantitatively evaluated:

- On-site laborer/security worker
- Off-site resident (inhalation only)
- On-site residents (redevelopment)
- Construction worker (during redevelopment)

A summary of RME risk results for SWMU 7 is shown in Table 5-83 and of CTE risk results in Table 5-84.

For the current/future on-site laborer/security worker, all scenarios were found to fall within or below the target risk range of 1E-04 to 1E-06 for the ILCR and unity for the total HI. For the RME scenario, an ILCR on the order of 1E-05 was estimated for exposure to surface soil from the Northwest Test Area Trench area of concern as well as exposure to surface soils on a SWMU-wide basis. A major factor in the risk analysis is the method proposed by USEPA (1989a) for estimation of a dermal slope factor based on oral absorption. Nonlipophilic chemicals (e.g., inorganic salts) are poorly absorbed (USEPA 1992c) and seldom present significant risk via this route of exposure. Dermal exposure assessment guidance (USEPA 1992c) does not include quantitative evaluation of this pathway for metals. As a result, estimates for dermal absorption risk from inorganics are likely to be overstated. These risk results are also conservative because it was assumed that the on-site laborer/security worker would be working at the same area of concern or SWMU for the entire length of service. However, based on the job description for this receptor, continued exposure to a single location is very unlikely.

The ILCRs for both adult and child RME off-site residents were below the target risk range of 1.0E-06. The child HI for inhalation of particulates is slightly above unity, 1.5 to 2.0 for the RME and CTE scenarios, respectively. It should be remembered that any estimate of risk is dependent on the concurrent validity of all assumptions used to construct the exposure model. In other words, the estimates rely on several activities recurring with constant intensity and in predictable order. For example, particulate inhalation assumes a constant inhalation rate every day for durations up to 18 years at the SWMU boundary and that all air inhaled came from SWMU 7 only. Additionally, for the hypothetical resident, all EPCs are estimated at the facility boundary. These assumptions will likely result in an overestimate of actual risk.

The ILCRs for the child RME on-site residents were within or below the target risk range of 1.0E-04 to 1.0E-06, while the adult RME on-site resident ILCR slightly exceeded the risk range at 1.2E-04. The total adult resident HI (1.2) is slightly above unity. However, no specific pathway is above unity. The total child resident HI ranges from 2.1 to 2.6 with the driving pathway being inhalation of particulates. As stated above, particulate inhalation assumes (1) a constant inhalation rate every day for durations up to 18 years at the SWMU and (2) all air inhaled comes from SWMU 7 only. Additionally, the HI estimation assumes additivity of effects for all COPCs evaluated. Unless each COPC effect is focused on the same endpoint (target organ), the HI estimate is likely to be overstated.

The ILCRs for the future construction worker were within or below the target risk range of 1.0E-04 to 1.0E-06. The total HI is below unity with the exception of the Northwest Test

Table 5-83. Summary of RME Risk Results for SWMU 7

Scenario	Firing Point		Northwest Test Area Trench		Bullet Stop		SWMU as a Whole	
	HI	ILCR	HI	ILCR	HI	ILCR	HI	ILCR
Current Land Use								
On-site Laborer	---[a]	---	2.0E-01	4.4E-05	4.8E-01	1.6E-08	2.0E-01	3.8E-05
Off-site Adult Resident	---	---	---	---	---	---	5.5E-01	2.8E-08
Off-site Child Resident	---	---	---	---	---	---	1.5E+00	4.4E-08
Adult Beef Consumer	---	---	---	---	---	---	4.8E-04	8.5E-08
Child Beef Consumer	---	---	---	---	---	---	7.3E-04	7.8E-08
Future Land Use								
On-site Adult Resident	---	---	1.2E+00	1.2E-04	8.5E-01	2.8E-08	---	---
On-site Child Resident	---	---	2.6E+00	5.3E-05	2.1E+00	4.5E-08	---	---
Construction Worker	1.4E-01	6.9E-06	1.3E+01	1.5E-05	2.4E-01	7.3E-06	---	---

[a]Not evaluated.

Table 5-84. Summary of CTE Risk Results for SWMU 7

Scenario	Firing Point		Northwest Test Area Trench		Bullet Stop		SWMU as a Whole	
	HI	ILCR	HI	ILCR	HI	ILCR	HI	ILCR
Current Land Use								
On-site Laborer	---[a]	---	1.4E-02	2.5E-08	1.3E-02	6.8E-11	1.5E-02	2.0E-08
Off-site Adult Resident	---	---	---	---	---	---	3.9E-01	5.3E-09
Off-site Child Resident	---	---	---	---	---	---	2.0E+00	2.7E-08
Future Land Use								
On-site Adult Resident	---	---	5.1E-01	2.4E-06	4.5E-01	5.4E-09	---	---
On-site Child Resident	---	---	2.4E+00	4.1E-06	2.2E+00	2.7E-08	---	---
Construction Worker	3.1E-02	5.1E-07	3.1E+00	2.8E-07	5.00E-02	5.40E-07	---	---

[a]Not evaluated.

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Area Trench. HIs for this area of concern range from 1.3E+01 to 3.1E+00 for the RME and CTE scenarios, respectively, with the driving pathway being inhalation of particulates. As stated above, particulate inhalation assumes (1) a constant inhalation rate every day for durations up to 3 years at the SWMU and (2) all air inhaled comes from subsurface soils at SWMU 7 only.

When site-specific conditions are considered along with the conservative assumptions designed to offset assessment uncertainties, the risk estimates for the future residential scenario are, in point of fact, likely to be overestimates. Under the current BRAC, SWMU 7 is not included in the parcel for potential release for private redevelopment. The mission of SWMU 7 is assumed to continue into the indefinite future. Based on the available analytical data and the above considerations, the risk assessment results indicate that there is no immediate and substantial danger to human health from the presence of low levels of hazardous chemicals at SWMU 7.

5.2.5 Conclusions and Recommendations

During the summer of 1994, the Chemical Range (SWMU 7) Phase II field investigation was conducted to further characterize the area of two previously open disposal trenches at the east end (firing point) and to investigate additional areas that were not sampled during Phase I. To accomplish this, three areas at SWMU 7 were investigated: (1) the Firing Point Area, (2) the Northwest Test Area Trench, and (3) the Bullet Stop and Firing Course Area. Soil sampling along with a geophysical survey were utilized to perform the characterization.

A total of 15 test pits were excavated and sampled along with sampling at 18 surface soil locations. All but five of the pits were sampled at the approximate depths of 0.5, 5, and 10 feet (CRP-94-01 through -05 were sampled at depths of 5, 7, 9, and 10 feet). All of the soil samples were analyzed for metals, explosives, and SVOCs. Metals exceeding background were detected in some of the soil samples from SWMU 7. No explosives were detected in any of the samples, and only a few traces of SVOCs were detected from the samples collected at SWMU 7. It is important to note that even though metals exceeding background were detected in some of the soil samples from each of the three areas, it appears that the only significant concentrations are in the immediate vicinity of the bullet stop. Metal debris that is the likely source of other elevated metals was also encountered during the sampling at the firing point and northwest test area trench.

Risk assessment results indicate that current scenario risks and hazards are below or within regulatory risk-based criteria with the exception of the off-site child resident where the CTE and RME HI exceeds unity (2.0 and 1.5, respectively) due to inhalation of particulates (metals).

Results for future land use scenarios indicate that the Northwest Test Area Trench area of concern has some associated risks that exceed regulatory criteria. This includes the RME HI (1.2) for the future on-site adult resident; and the CTE and RME HI (2.4 and 2.6,

respectively) for the future on site child resident; the CTE and RME HI (3.1 and 1.3, respectively) for the future on-site construction worker. These risks are also primarily related to inhalation of particulates (metals).

The future on-site child resident also had HIs exceeding unity at the Bullet Stop area of concern with a CTE HI of 2.2 and RME HI of 2.1. These hazards are also primarily related to inhalation of particulates (metals).

The results of the ecological risk assessment for SWMU 7 are presented in the TEAD SWERA (Rust E&I 1996).

Based on the results of the human health risk assessment, it appears that the Northwest Test Area Trench may pose an unacceptable risk to human health as a result of airborne particulates. It should be noted that the risk estimates for this pathway may be overestimated as described in Section 5.2.4.6. This area of concern and potential exposure pathway should be addressed during the feasibility study for this SWMU. TEAD has submitted plans to conduct a voluntary removal action at the Northwest Test Area Trench to reduce these risks to acceptable levels. No further remedial investigations appear to be warranted at SWMU 7. However, it will be carried forward to the feasibility study as required by CERCLA to determine whether any remedies are required for this SWMU. Conclusions from this report and the SWERA will be used during the FS process to derive final recommendations for SWMU 7.

The debris and UXO surveys along with the test pit excavation results at SWMU 7 indicate that none of the material that was encountered in the pits was live. However, this is not 100-percent assurance that there is no live UXO at this SWMU. It is, therefore, recommended that UXO clearance be provided prior to any work or sampling at SWMU 7. Additionally, prior to granting any future land use activities, it is recommended that the entire SWMU be surveyed for UXO to a depth that is appropriate for the given future land use application. Along with this surveying, additional soil sampling for antimony and thallium may be necessary before releasing the land for future residential use. This information will be carried through the FS and ROD process.

5.3 TIRE DISPOSAL AREA (SWMU 13)

5.3.1 Site Characteristics

The Tire Disposal Area, located in the southern portion of TEAD-N (see Figure 1-2), consists of an 11-acre pit that was formed during previous gravel-mining operations. Unreclaimable tire carcasses from TEAD-N vehicles were disposed of in the former gravel-mining pit starting in 1965. Thousands of tires were placed on the ground surface of the pit and, in some areas of the pit, the tires were covered with gravel. The majority of the tires, however, had lain exposed on the ground surface. A site walkover was conducted during the Phase I RI field activities to determine if there was evidence of the disposal of any other potentially hazardous materials. The visual survey of the site during the RI revealed that approximately 100,000 tires were placed in SWMU 13, of which about 85 percent were 20-inch truck tires, 10 percent were 16-inch automobile tires, and 5 percent were heavy equipment tires. With the exception of wooden pallets, no other types of waste disposal activities appeared to have occurred at Site 13. Photographs of the Tire Disposal Area taken during the Phase II investigation are presented in Appendix C. Subsequent to the Phase I RI field activities, all of the tires were removed off-site for reuse. After the tires were removed, the floor of the pit was graded smooth and berms were pushed up to block most potential entrances. The tire disposal pit was free of most surface debris, and only the impressions of the tires were still visible on the floor and sides of the pit. During the Phase II RI subsurface soil sampling, however, several tires and other wood and metal debris were uncovered.

5.3.2 Previous Investigations and Phase I and Phase II RI Activities

No environmental investigations, sampling, or analysis had been performed at the Tire Disposal Area prior to the Phase I RI field activities because of the relative stability of the tires, resulting in a low potential for contaminant releases. A site walkover was conducted during the Phase I RI field activities to determine if there was evidence of the disposal of any other potentially hazardous materials. The results of this walking survey indicated that no other types of waste disposal were conducted at this SWMU. Some concern, however, remained over the possibility of soil contamination that may have resulted from the tire disposal operation. As a result, environmental sampling was scheduled for the Phase II RI field activities.

Phase II RI field work was performed in the summer of 1994. Fifteen test pits were excavated to a depth of 5 feet in the tire disposal pit (Figure 5-10). Originally, borings were scheduled to be drilled in SWMU 13 but, because of the coarse gravel, samples were collected from test pits that were excavated by a backhoe. Samples were collected at depths of 0 to 6 inches and 5 feet and analyzed for metals, SVOCs, and VOCs. The sampling was conducted across the entire pit area of SWMU 13, including areas of surface staining (sample locations TDP-94-08 and -11). Concrete construction debris, metal bands, wood debris, and scraps of rubber were found scattered on the surface of the tire disposal pit. A tire was found in test pit TDP-94-04. From the 15 test pits, the maximum depth of buried debris was 3 feet bgs with most debris encountered at or near the surface.

5.3.3 Contamination Assessment

5.3.3.1 *Data Evaluation*

This section evaluates the analytical data for its usability in the risk assessment. A data evaluation was performed by reviewing the data quality codes assigned by the USAEC Chemistry Branch and EcoChem, an independent third-party validator. In an effort to ascertain the level of certainty/uncertainty, USEPA data qualification codes were then assigned as an aid in interpreting the data for use in the risk assessment. (Table 2-4 defines the relationship between the USAEC Chemistry Branch codes and USEPA data qualifiers.) The sections summarize the results of this process.

5.3.3.1.1 ***Field Duplicates.*** The "D" flag code represents a field duplicate. All "D" flagged data were compared with the primary investigative result, and the higher of the two values was used in the quantitative risk assessment.

5.3.3.1.2 ***Blank Assessment.*** The USEPA has determined that when blank contamination exists, the investigative results must exceed the blank result by a factor of 5 (all compounds) or 10 (common laboratory contaminants such as acetone) in order to be considered positive. Several metals were detected in method and or rinsate blanks associated with SWMU 13 soil samples. Based on comparisons to blanks, positive metals results were changed to nondetects for the following samples. According to USEPA guidance (USEPA 1989), the associated blank concentration was considered the quantitation limit for the affected samples.

- Surface Soil
  - –Aluminum—TDP-94-01A, -06A, -08A, -09A (and duplicate), -10A, -11A, and -15A
  - –Barium—TDP-94-06A, -08A, -09A (and duplicate), -10A, -11A, and -15A
  - –Iron—TDP-94-01A, -08A, -09A, -10A, -11A, and -12A
  - –Manganese—TDP-94-01A, -06A, -08A, -09A (and duplicate), -10A, -11A, and -12A
  - –Nickel—TDP-94-08A, -09A, -10A, -11A, and -12A
  - –Potassium—TDP-94-06A, -08A, -09A (and duplicate), -10A, -11A, and -15A
  - –Vanadium—TDP-94-01A, -02A, -06A, -08A, -09A (and duplicate), -10A, -11A, -12A, and -15A
  - –Zinc—TDP-94-09A

- Subsurface Soil
  - –Aluminum—all samples
  - –Barium—all samples
  - –Iron—TDP-94-06B, -07B, -08B, -09B (and duplicate), -10B, -12B, and -13B
  - –Manganese—all samples <u>except</u> TDP-94-03B
  - –Potassium—all samples
  - –Vanadium—all samples <u>except</u> TDP-94-11B, -14B, and -15B
  - –Zinc—TDP-94-01B, -02B, -08B, -09B, -10B, and -12B

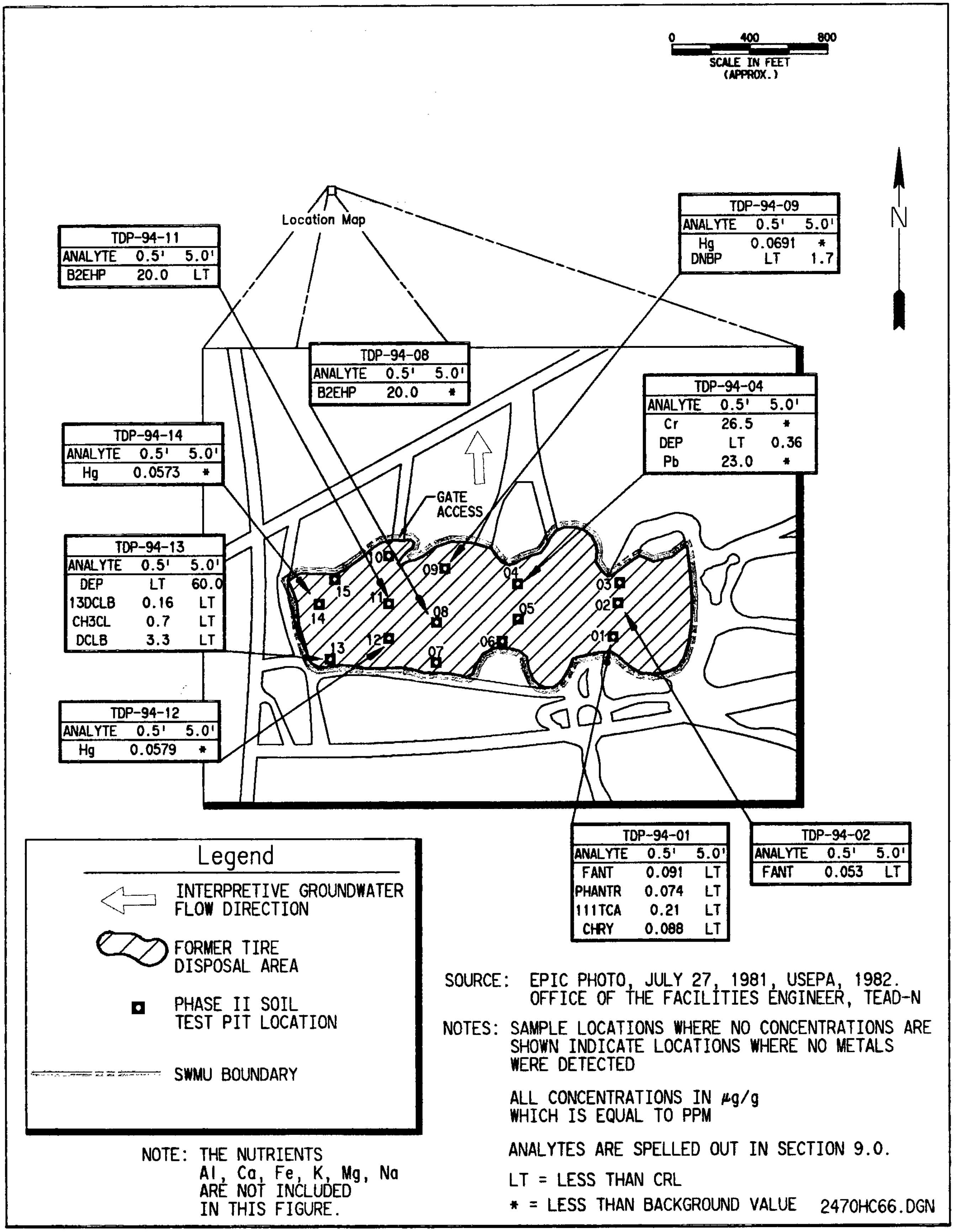

Figure 5-10. SWMU 13 Phase II Sample Locations and Results

5.3.3.1.3 ***USAEC Chemistry Branch Validation.*** The USAEC Chemistry Branch reviewed the analytical data for technical deficiencies based on the *USATHAMA (USAEC) Quality Assurance Program (PAM 11-41)*. USAEC data qualifiers assigned by the Chemistry Branch would be an indication of QC recoveries outside of USAEC control limits and other technical deficiencies. Estimating the data for use in the risk assessment based on USAEC data qualifiers is judged to be a conservative approach since USAEC control limits are generally narrower than USEPA Functional Guidelines.

For SWMU 13, the USAEC assigned qualifiers to mercury in Lot ANUB due to a high low-spike recovery (145 percent). Detected values were estimated (J) and considered biased high. No data were rejected for use.

Non-Certified Compounds. USAEC flag codes of R or T were assigned by the analytical laboratory to indicate non-detected compounds that had not been performance demonstrated or validated under the USAEC's 1990 QA program. Under this program a distinction is made between "target" and "non-target" analytes. "Target" compounds are determined during the certification process, and CRLs for these analytes are established. "Non-target" compounds are those that were added to the method to meet project-specific requirements. The lowest calibration standard typically reflects the PQL for that analyte. For the purpose of the risk assessment, the detection limit was assigned a J-code, due to the uncertainty associated with not having undergone a rigorous certification process.

5.3.3.1.4 ***Independent Third-Party Data Validation.*** A data quality assessment was completed using a validation effort by EcoChem, an independent third party. EcoChem's review and recommendations were based on USEPA Functional Guidelines as well as the *USATHAMA (USAEC) Quality Assurance Program (PAM 11-41)* and individual methods. All USEPA data qualifiers recommended by EcoChem were incorporated for use in the risk assessment and are provided in the analytical summary tables of Appendix J.

For SWMU 13, EcoChem evaluated volatile organic analyses of soil samples by Method LM23 and one lot of semivolatile organic analyses of soil samples by Method LM25. Several SWMU 13 samples were also included as part of the data quality assessment of ICP metals analyses for SWMU 13 and are addressed below.

For the volatile analyses, Lot ANRP, EcoChem found all data to be acceptable for use without qualification.

For the semivolatile analyses, Lot ANQQ, EcoChem rejected (R) toxaphene and three PCB aroclor (1016, 1260, 1262) reporting limits. These compounds were not scanned for (except as unknown compounds).

For the ICP-metals analyses, Lot ANVM, EcoChem rejected all antimony detection limits due to 0 percent recovery in the MS/MSD. The USAEC did not flag this problem because natural spikes are not part of the USAEC QA program.

Listed below are the sample results rejected for use in the risk assessment:

- Surface Samples
  –Toxaphene - TDP-94-03A, -04A, -05A, 06A, 07A
  –PCB 1016 - TDP-94-03A, -04A, -05A, 06A, 07A
  –PCB 1260 - TDP-94-03A, -04A, -05A, 06A, 07A
  –PCB 1262 - TDP-94-03A, -04A, -05A, 06A, 07A
  –Antimony - TDP-94-03A, -04A, -05A, 06A, 07A, -09A and dup, -13A, -14A, 15A

- Subsurface Samples
  –Toxaphene - TDP-94-03B, -04B, -05B, 06B, 07B
  –PCB 1016 - TDP-94-03B, -04B, -05B, 06B, 07B
  –PCB 1260 - TDP-94-03B, -04B, -05B, 06B, 07B
  –PCB 1262 - TDP-94-03B, -04B, -05B, 06B, 07B
  –Antimony - TDP-94-03B, -04B, -05B, -06B, -07B, -09B and dup, -13B, -14B, 15B

5.3.3.1.5 ***Data Evaluation Summary.*** A total of 15 surface soil samples (and 1 duplicate) and 15 subsurface soil samples (and 1 duplicate) were collected in 1994 from 15 test pits at SWMU 13. Subsurface samples were collected at a depth of 5 feet. Samples were analyzed for semivolatiles, volatiles, and metals.

Because of blank contamination, positive results for a number of metals were changed to nondetects. However, in every case, the detected value in the affected sample was below the background screening level for the metal. Therefore, this issue does not significantly impact the risk assessment results.

The following metals were not detected within surface or subsurface soil, yet their reporting limits exceeded their background screening values: antimony, cadmium, silver, and thallium. The high reporting limits for cadmium (1.2 μg/g) and silver (0.80 μg/g) were less than their respective ingestion and soil-to-air RBCs, however. Therefore, this issue does not significantly impact the risk assessment results for these chemicals.

The antimony and thallium reporting limits exceed the ingestion RBCs for these metals. Additionally, 18 antimony results were rejected due to poor matrix spike recoveries. Therefore, the magnitude and extent of antimony and thallium contamination may not be adequately characterized at this SWMU. However, PRGs calculated for both metals by Dames and Moore (1996) under current land use scenarios are well above the reporting limits indicating that no data gap exists. Additional sampling would be required should the property be considered for unrestricted residential land use.

Ten nondetect results for each of the following semivolatiles were rejected because the compounds were not included in the initial and continuing calibration standard: PCB 1016, PCB 1260, PCB 1262, and toxaphene. No detections of other PCB congeners were reported, and the historical use of this SWMU does not suggest that PCBs would be present in soils. Therefore, this issue does not significantly impact the risk assessment results for these chemicals.

Over 99 percent of sample results were judged to be usable for risk assessment purposes. In general, the number of samples and the analytical parameter list appear to be sufficient to characterize the nature, extent, and potential magnitude of contamination at this SWMU with the exceptions noted above. A summary of chemicals detected in at least one surface or subsurface sample at SMWU 13 is presented in Appendix J, including data qualifiers (as appropriate) according to USEPA functional guidelines.

5.3.3.1.6 *Background Screening*

The maximum concentrations of inorganic chemicals detected in soil at SWMU 13 were compared to the site-specific background screening values (see Section 2.6). Any inorganic chemical detected in at least one sample at a concentration higher than the background screening value was retained in the COPC database. Surface soil and subsurface soil were screened separately. The results of the background screening are shown in Table 5-85. Based on this screening analysis, chromium, lead, magnesium, and mercury are the only inorganic analytes that should be considered potential contaminants at SWMU 13. Each of these contaminants is only found in surface soil.

5.3.3.2 *Summary of Analytical Results*

The list of analytes detected in at least one surface or subsurface soil sample is provided in Table 5-86 for Phase II data. The complete data set is contained in Appendix H.

5.3.3.3 *Nature and Extent of Contamination*

Figure 5-10 is a contaminant distribution map for SWMU 13.

Based on Phase II sampling results, mercury, lead, chromium, and magnesium were the only metals detected above their associated background screening values (0.0572, 18.23, 20.62, and 7,062 μg/g, respectively). Mercury concentrations ranged from 0.0573 to 0.0691 μg/g in surface soils collected from test pits TDP-94-09, TDP-94-12, and TDP-94-14. Mercury was primarily limited to surface soil from the western half of the disposal area (see Figure 5-10).

Chromium and lead were detected above their respective background screening values in only one sample (TDP-94-04A). Surface soil collected from this test pit contained 26.5 μg/g of chromium and 23 μg/g of lead (see Table 5-86).

Magnesium exceeded its background screening value in two surface soil samples; TDP-94-04A had a concentration of 7,690 μg/g, and TDP-94-05A had a concentration of 8,460 μg/g.

Phase II RI samples were also analyzed for SVOCs and VOCs. SVOCs and VOCs were detected at low concentrations in both surface and subsurface soils at 7 of the 15 test pits. The VOC and SVOC analytical results are included in Table 5-86.

Table 5-85. Background Screening of Inorganic Chemicals Detected in Soil at SWMU 13

Chemical	Frequency of Detection	Maximum Detected Value ($\mu g/g$)[a]	Site-specific Background Screening Value[b] ($\mu g/g$)	Exceeds Site-specific Background[c]
Surface Soil (0-0.5 ft)				
Aluminum	8/15	12,600	28,083	No
Arsenic	13/15	6.93	11.69	No
Barium	9/15	84.7	247	No
Beryllium	1/15	0.518	1.46	No
Calcium	15/15	70,000	114,483	No
Chromium	15/15	26.5	20.62	**YES**
Cobalt	6/15	4.74	6.94	No
Copper	15/15	20.0	24.72	No
Iron	14/15	13,300	22,731	No
Lead	11/15	23.0	18.23	**YES**
Magnesium	15/15	8,460	7,062	**YES**
Manganese	8/15	209	698	No
Mercury	4/15	0.069	0.0572	**YES**
Nickel	8/15	9.16	17.4	No
Potassium	9/15	3,340	5,450	No
Sodium	15/15	263	337	No
Vanadium	6/15	21.6	28.39	No
Zinc	15/15	59.3	102.8	No
Subsurface Soil (0.5 - 10 ft)				
Arsenic	5/15	3.97	11.69	No
Calcium	15/15	48,800	114,483	No
Chromium	15/15	15.7	20.62	No
Cobalt	3/15	3.08	6.94	No
Copper	5/15	3.94	24.72	No
Iron	13/15	9,760	22,731	No
Magnesium	15/15	5,910	7,062	No
Manganese	2/15	104	698	No
Mercury	1/15	0.052	0.0572	No
Nickel	6/15	5.06	17.40	No
Sodium	15/15	232	337	No
Vanadium	4/15	25.2	28.39	No
Zinc	10/15	17.5	102.8	No

[a]Micrograms per gram.
[b]See Section 2.6.1.1 for an explanation of how the site-specific background screening values were calculated.
[c]number of samples in which the analyte was detected/total number of samples analyzed.

Table 5-86. Summary of Analytes Detected in Soil for the Tire Disposal Area (SWMU 13) - Phase II

Surface Soil

Group	Analytes	Background Concentrations	TDP-94-01A (0.5ft)	TDP-94-02A (0.5ft)	TDP-94-03A (0.5ft)	TDP-94-04A (0.5ft)	TDP-94-05A (0.5ft)	TDP-94-06A (0.5ft)	TDP-94-07A (0.5ft)	TDP-94-08A (0.5ft)	TDP-94-09A (0.5ft)	TDP-94-09A(D) (0.5ft)
METALS	ALUMINUM	28083	3230#	4160	8600	12600	7540	1720#	6940	1930#	2630#	2480#
	ARSENIC	11.69	6.93	4.25	4.84	6.1	4.03	LT 2.5	2.75	2.81	2.81	2.53
	BARIUM	247.1	42.2	54.9	74.8	84.7	73.2	15.5#	54.6	24.5#	32.1#	30.2#
	BERYLLIUM	1.455	LT 0.427	LT 0.427	LT 0.427	0.518	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427
	CALCIUM	114483	30100	35200	46900	70000	52600	43000	32000	43900	24700	25300
	CHROMIUM	20.62	4.91	5.95	11.6	26.5*	14.5	3.41	8.61	4.85	4.82	6.03
	COBALT	6.94	LT 2.5	LT 2.5	3.43	4.74	3.33	LT 2.5	3.5	LT 2.5	LT 2.5	LT 2.5
	COPPER	24.72	3.38	4.17	7.77	20	9.05	3.72	6.39	6.08	6.81	5.31
	IRON	22731	4580#	5310	9340	13300	9070	5580	9060	4140#	4410#	4870
	LEAD	18.23	14.7	10	LT 7.44	23*	11.7	LT 7.44	7.78	LT 7.44	LT 7.44	LT 7.44
	MAGNESIUM	7061	3540	4110	4750	7690*	8460*	3670	4440	3970	2630	2330
	MANGANESE	698.3	98.5#	121	170	200	204	72.7#	160	78.9#	75.4#	74.3#
	MERCURY	0.0572	LT 0.05	LT 0.05	LT 0.05	0.0563	LT 0.05	LT 0.05	LT 0.05	LT 0.05	0.0691*	LT 0.05
	NICKEL	17.4	LT 2.74	LT 2.74	5.33	9.16	6.32	3.55	5.53	9.15#	9.16#	LT 2.74
	POTASSIUM	5449	878	1160	2520	3340	1910	415#	1650	434#	743#	587#
	SODIUM	337	199	192	263	256	258	70.2	154	112	72.1	134
	VANADIUM	28.39	6.26#	7.21#	15.7	21.6	15.9	4.61#	12.2	6.15#	5.94#	5.68#
	ZINC	102.8	25	21.8	29.2	49.9	36.4	13.5	26.8	31.7	12.5#	13.9
SEMIVOLATILES	BIS (2-ETHYHEXYL) PHTHALATE	N/A	LT 0.48	LT 0.48	LT 0.48	LT 0.48	LT 0.48	LT 0.48	LT 0.48	20*	LT 0.48	LT 0.48
	CHRYSENE	N/A	0.088*	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.3	LT 0.032	LT 0.032
	FLUORANTHENE	N/A	0.091*	0.053*	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.3	LT 0.032	LT 0.032
	PHENANTHRENE	N/A	0.074*	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.3	LT 0.032	LT 0.032
VOLATILES	1,1,1-TRICHLOROETHANE	N/A	0.21*	LT 0.2	LT 0.2	LT 0.2	LT 0.2	LT 0.2	LT 0.2	LT 0.2	LT 0.2	LT 0.2
	1,3-DICHLOROBENZENE	N/A	LT 0.14	LT 0.14	LT 0.14	LT 0.14	LT 0.14	LT 0.14	LT 0.14	LT 0.14	LT 0.14	LT 0.14
	CHLOROMETHANE	N/A	LT 0.96	LT 0.96	LT 0.96	LT 0.96	LT 0.96	LT 0.96	LT 0.96	LT 0.96	LT 0.96	LT 0.96
	DICHLOROBENZENE - NONSPECIFIC	N/A	LT 0.2	LT 0.2	LT 0.2	LT 0.2	LT 0.2	LT 0.2	LT 0.2	LT 0.2	LT 0.2	LT 0.2

Table 5-86. Summary of Analytes Detected in Soil for the Tire Disposal Area (SWMU 13) - Phase II (continued)

Surface Soil

Group	Analytes	Background Concentrations	TDP-94-10A (0.5ft)	TDP-94-11A (0.5ft)	TDP-94-12A (0.5ft)	TDP-94-13A (0.5ft)	TDP-94-14A (0.5ft)	TDP-94-15A (0.5ft)
METALS	ALUMINUM	28083	3050#	2550#	6770	8180	9960	3790#
	ARSENIC	11.69	4	3.06	3.95	3.88	4.76	LT 2.5
	BARIUM	247.1	28#	23.6#	54.5	59.3	80.1	34.1#
	BERYLLIUM	1.455	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427
	CALCIUM	114483	30600	32700	35400	31400	29400	30500
	CHROMIUM	20.62	7.21	3.22	7.61	10.9	11.9	5.82
	COBALT	6.94	LT 2.5	LT 2.5	LT 2.5	3.39	3.65	LT 2.5
	COPPER	24.72	9.05	8.91	12.4	8.6	8.3	6.71
	IRON	22731	5160#	4780#	8000#	9770	10700	5710
	LEAD	18.23	10.6	9.24	7.98	10.4	8.45	10.2
	MAGNESIUM	7061	3740	4400	4250	4420	5040	3570
	MANGANESE	698.3	84#	75.1#	120#	147	209	105
	MERCURY	0.0572	LT 0.05	LT 0.05	0.0579*	LT 0.05	0.0573*	LT 0.05
	NICKEL	17.4	9.35#	10.3#	12.6#	6.08	5.98	3.87
	POTASSIUM	5449	784#	526#	1560	2050	2310	883#
	SODIUM	337	119	71.4	131	165	208	120
	VANADIUM	28.39	7.91#	6.59#	11.7#	14.1	15.7	7.75#
	ZINC	102.8	18.7	59.3	30.1	37.2	38	21.7
SEMIVOLATILES	BIS (2-ETHYHEXYL) PHTHALATE	N/A	LT 0.48	20*	LT 0.48	LT 0.48	LT 0.48	LT 0.48
	CHRYSENE	N/A	LT 0.032	LT 0.3	LT 0.032	LT 0.032	LT 0.032	LT 0.032
	FLUORANTHENE	N/A	LT 0.032	LT 0.3	LT 0.032	LT 0.032	LT 0.032	LT 0.032
	PHENANTHRENE	N/A	LT 0.032	LT 0.3	LT 0.032	LT 0.032	LT 0.032	LT 0.032
VOLATILES	1,1,1-TRICHLOROETHANE	N/A	LT 0.2	LT 0.2	LT 0.2	LT 0.2	LT 0.2	LT 0.2
	1,3-DICHLOROBENZENE	N/A	LT 0.14	LT 0.14	LT 0.14	0.16*	LT 0.14	LT 0.14
	CHLOROMETHANE	N/A	LT 0.96	LT 0.96	LT 0.96	0.7*	LT 0.96	LT 0.96
	DICHLOROBENZENE - NONSPECIFIC	N/A	LT 0.2	LT 0.2	LT 0.2	3.3*	LT 0.2	LT 0.2

Subsurface Soil

		Background Concentrations	TDP-94-01B (5ft)	TDP-94-02B (5ft)	TDP-94-03B (5ft)	TDP-94-04B (5ft)	TDP-94-05B (5ft)	TDP-94-06B (5ft)	TDP-94-07B (5ft)	TDP-94-08B (5ft)	TDP-94-09B(D) (5ft)	TDP-94-09B (5ft)
METALS	ARSENIC	11.69	LT 2.5	2.57	3.04	LT 2.5	LT 2.5	LT 2.5	LT 2.5	3.87	LT 2.5	LT 2.5
	CALCIUM	114483	48800	29600	42600	36800	28300	32100	8810	33200	33100	39700
	CHROMIUM	20.62	2.02	1.99	14.2	4.1	4.31	3.62	2.48	3.32	5	5.52
	COBALT	6.94	LT 2.5	LT 2.5	2.83	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5
	COPPER	24.72	LT 2.84	LT 2.84	LT 2.84	LT 2.84	3.52	LT 2.84	LT 2.84	3.19	LT 2.84	3.43
	IRON	22731	3720#	2550#	9110	6400	4860	4240#	1720#	4130#	4600#	5230#
	MAGNESIUM	7061	4490	1620	4220	3860	3260	2540	974	2840	3180	5910
	MANGANESE	698.3	71.6#	41.9#	104	59.3#	66.8#	49.8#	16.9#	59.5#	54.3#	89.4#
	MERCURY	0.0572	LT 0.05	LT 0.05	LT 0.05	0.0519	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	LT 2.74	LT 2.74	3.72	5.06	3.73	3.23	LT 2.74	9.24#	LT 2.74	9.84#
	SODIUM	337	141	232	167	187	138	109	66.5	74.4	201	101
	VANADIUM	28.39	3.06#	3.66#	22.4	7.54#	6.94#	5.94#	3.42#	5.27#	7.39#	9.34#
	ZINC	102.8	9.86#	6.64#	17.5	12.2	11	7.52	3.21	7.45#	8.76	9.26#
SEMIVOLATILES	DI-N-BUTYL PHTHALATE	N/A	LT 1.3	LT 1.3	LT 1.3	LT 1.3	LT 1.3	LT 1.3	LT 1.3	LT 1.3	LT 1.3	1.7*
	DIETHYL PHTHALATE	N/A	LT 0.24	LT 0.24	LT 0.24	0.36*	LT 0.24	LT 0.24	LT 0.24	LT 0.24	LT 0.24	LT 0.24

Table 5-86. *Summary of Analytes Detected in Soil for the Tire Disposal Area (SWMU 13) - Phase II (continued)*

Subsurface Soil

Group	Analytes	Background Concentrations	TDP-94-10B (5ft)	TDP-94-11B (5ft)	TDP-94-12B (5ft)	TDP-94-13B (5ft)	TDP-94-14B (5ft)	TDP-94-15B (5ft)
METALS	ARSENIC	11.69	LT 2.5	3.39	LT 2.5	LT 2.5	LT 2.5	3.97
	CALCIUM	114483	32600	38500	11300	14200	35200	37300
	CHROMIUM	20.62	8.72	15.7	1.38	2.12	9.32	12
	COBALT	6.94	LT 2.5	2.66	LT 2.5	LT 2.5	LT 2.5	3.08
	COPPER	24.72	3.78	3.94	LT 2.84	LT 2.84	LT 2.84	LT 2.84
	IRON	22731	6480#	9760	2230#	1930#	6910	8700
	MAGNESIUM	7061	4560	5700	1710	1640	4150	4120
	MANGANESE	698.3	67#	101#	19.8#	22.5#	73.6#	97.4
	MERCURY	0.0572	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	10.2#	12.1#	8.16#	LT 2.74	4.08	4.65
	SODIUM	337	99	126	74.5	59.1	167	110
	VANADIUM	28.39	13.4#	25.2	4.47#	3.47#	14.5	18.8
	ZINC	102.8	12#	17.2	3.6#	4.06	13.7	15.4
SEMIVOLATILES	DI-N-BUTYL PHTHALATE	N/A	LT 1.3	LT 1.3	LT 1.3	LT 10	LT 1.3	LT 1.3
	DIETHYL PHTHALATE	N/A	LT 0.24	LT 0.24	LT 0.24	60*	LT 0.24	LT 0.24

Note.- All values in $\mu g/g$ (equal to ppm).
N/A = Not Applicable.
# = Analyte was detected in the associated blank in excess of the 5 or 10 times rule (as described in Section 3.1.1.1).
LT = Analyte concentration is less than CRL , the CRL is posted next to the "LT".
* = Organic analyte detected above CRL or MDL or detected inorganic analyte exceeding background.
(D) = Duplicate analysis.

The SVOCs detected include fluoranthene, phenanthrene, chrysene, diethyl phthalate, bis (2-ethylhexyl) phthalate, di-n-butyl phthalate, and unknowns. The unknowns are presented in Appendix P.

Fluoranthene was detected in surface soils collected from test pits TDP-94-01 and -02 in concentrations of 0.091 and 0.053 μg/g, respectively. Phenanthrene and chrysene were also detected in surface soil from TDP-94-01 at concentrations of 0.074 and 0.088 μg/g, respectively. Subsurface soil samples collected from test pits TDP-94-04 and -13 contained diethyl phthalate in concentrations of 0.36 and 60 μg/g. Bis (2-ethylhexyl) phthalate was detected in surface soils collected from test pits TDP-94-08 and -11, both containing 20 μg/g. Di-n-butyl phthalate was present in only one sample (subsurface soil from TDP-94-09) at a concentration of 1.7 μg/g, only slightly above the CRL for this compound.

The SVOC data were compared to laboratory QC method and trip blanks to determine if these compounds were laboratory contaminants. However, there was no direct correlation between the compounds detected in these specific soil samples and associated QC data, despite the fact that phthalate esters are common laboratory contaminants. The source of SVOCs is unknown. The surface staining present may be the result of leaking fluids (i.e., hydraulic fluid) from equipment used to remove the tires from the pit.

VOCs were detected in surface soil samples from test pits TDP-94-01 and -13. Surface soil collected from test pit TDP-94-01 contained 0.21 μg/g of 1,1,1-trichloroethane. The three remaining VOCs were all detected from surface soil collected from test pit TDP-94-13. The compounds 1,3-dichlorobenzene, chloromethane, and dichlorobenzene were present in concentrations of 0.16, 0.70, and 3.3 μg/g, respectively (see Figure 5-10). A QC data comparison resulted in no direct correlation between method and field blanks for the soil samples containing the detected VOCs, again suggesting these compounds are not laboratory contaminants. The source of these compounds is unknown. Since VOCs were not present at a depth of 5 feet, it does not appear that they have migrated vertically.

The lack of wide-spread contamination in the surface and subsurface soil within the former Tire Disposal Area indicates that no hazardous wastes were likely disposed within this area.

5.3.4 Human Health Risk Assessment

As part of the Phase II RI, an RA was conducted to estimate potential human health risks associated with the no-action alternative for SWMU 13, the Tire Disposal Area. The following tasks were completed in the RA:

- Data analysis and selection of COPCs
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Conclusions and recommendations

This section provides a summary of the quantitative process employed at SWMU 13 and the results of that process. The RA for SWMU 13 is based on the methodology described in Section 3.1 and supported by Appendices L, M, N, and O.

5.3.4.1 *Selection of the Chemicals of Potential Concern—Soil*

As detailed in Region VIII guidance, a screening procedure can be used to narrow the list of contaminants at a particular site to a subset of analytes that can be considered the COPCs for the area. This screening procedure can involve up to four steps, depending on the contaminants present:

- Group data by chemical class (e.g., carcinogenic PAHs)
- Evaluate frequency of detection
- Evaluate essential nutrients
- Compare site data to risk-based screening concentrations (Region III values)

Below is the screening analysis for SWMU 13.

5.3.4.1.1 ***Data Grouping.*** No data grouping was performed as part of COPC selection at SWMU 13.

5.3.4.1.2 ***Frequency of Detection.*** No evaluation of detection frequency was undertaken at this SWMU due to the small sample size (maximum n = 15 for both surface and subsurface soil).

5.3.4.1.3 ***Nutrient Screening.*** Magnesium was the only nutrient chemical detected above background in surface soil. Since the maximum concentration of magnesium (8,460 μg/g) was less than the nutrient screening value for this chemical (1,000,000 μg/g; see Section 3.1.1.2), magnesium was eliminated as a COPC in surface soil.

No nutrient chemicals were detected in subsurface soil above background screening values.

5.3.4.1.4 ***Region III RBC Screening.*** The final step in the COPC selection process consisted of comparing the EPCs for remaining contaminants in surface and subsurface soil with Region III RBCs. However, before these comparisons can be made, a "hot spot" analysis was conducted.

Hot Spot Analysis. For the final selection of COPCs, the SWMU was evaluated for possible "hot spots." Because the distance between many sample locations at this SWMU was wider than a 0.5-acre residential lot, individual sample locations were reviewed as potential hot spots

of contamination. A review of Figure 5-10, which shows sample locations and results, indicates sample locations TDP-94-11 and TDP-94-08 may be hot spots for bis(2-ethylhexyl)phthalate in surface soil. B2EHP was detected in these samples at a concentration of 20 $\mu g/g$, but was not detected in any other surface soil sample. Other potential hot spots include TDP-94-13, where three VOCs were detected in surface soil, and TDP-94-01, where three SVOCs were detected in surface soil. A potential hot spot in subsurface soil was located at TDP-94-13, where diethyl phthalate was detected at a concentration of 60 $\mu g/g$; this chemical was detected in only one other subsurface sample at a much lower concentration.

An initial hot spot screening analysis was accomplished by comparing the concentrations of potential COPCs at the above-mentioned locations with Region III RBCs based on residential exposure to soils through ingestion and inhalation (USEPA 1995). One-tenth of the RBC was used for noncarcinogens. The concentrations of chemicals at these locations were less than their respective RBCs, with the exception of chloromethane in surface soil and diethyl phthalate in subsurface soil at TDP-94-13. The concentrations in these samples (0.70 and 60 $\mu g/g$, respectively) exceeded the inhalation RBCs for these chemicals.

Since these exceedances occurred at only one sample location, a second screening step was performed. This consisted of calculating the upper 95% UCL concentration for these chemicals on all surface (chloromethane) and subsurface (diethyl phthalate) soil samples combined. Since the 95% UCL concentrations (0.52 and 3.96 $\mu g/g$, respectively) were less than the concentrations at TDP-94-13, sample location TDP-94-13 was selected as a hot spot at this SWMU. All other samples were combined to determine the EPCs associated with the remainder of the site.

Table 5-87 provides a summary of the EPCs for preliminary COPCs in surface and subsurface soil at SWMU 13. No inorganic analytes were detected above background in surface soil at the hot spot at TDP-94-13.

Soil-related Exposure Pathways. To select COPCs for the soil-related exposure pathways, the EPCs for the SWMU in surface and subsurface soil were compared to Region III soil ingestion and soil-to-air RBCs. As shown in Table 5-88, only two chemicals were retained as COPCs for these pathways at SWMU 13: chloromethane in surface soil and diethyl phthalate in subsurface soil at hot spot TDP-94-13.

5.3.4.1.5 ***Site-wide Soils.*** The concentrations of the COPC for surface soil—chloromethane—were calculated on a site-wide basis for the purpose of evaluating site-wide exposure scenarios. The site-wide concentrations were calculated utilizing all surface soil samples collected at SWMU 13. The site-wide concentration of chloromethane in surface soil COPCs is provided in Table 5-89.

Table 5-87. Summary of Preliminary Chemicals of Potential Concern (SWMU 13)

Chemical	Frequency of Detection[a]	Range of Detected Values (μg/g)[b]	Range of Reporting Limits (μg/g)	Arithmetic Mean Concentration (μg/g)	95% UCL[c] Concentration (μg/g)	Exposure Point Concentration[d] (μg/g)
Surface Soil - Hot Spot at TDP-04-13						
1,3-Dichlorobenzene	1/1	0.16	NA[e]	NA	NA	0.16
Chloromethane	1/1	0.70	NA	NA	NA	0.70
Dichlorobenzene	1/1	3.30	NA	NA	NA	3.30
Subsurface Soil - Hot Spot at TDP-04-13						
Diethyl phthalate	1/1	60	NA	NA	NA	60
Surface Soil - Remainder of Site						
Chromium	14/14	3.22 - 26.5	NA	8.60	12.4	12.4
Lead	10/14	7.78 - 23.0	7.44	9.20	13.2	13.2
Mercury	4/14	0.056 - 0.069	0.05	0.035	0.044	0.044
Bis(2-ethylhexyl)-	2/14	20.0	0.48	1.38	10.1	10.1
Chrysene	1/14	0.088	0.03 - 0.30	0.035	0.070	0.070
Fluoranthene	2/14	0.053 - 0.091	0.03 - 0.30	0.039	0.079	0.079
Phenanthrene	1/14	0.074	0.03 - 0.30	0.035	0.067	0.067
1,1,1-Trichlorethane	1/14	0.210	0.20	0.107	0.119	0.119
Subsurface Soil - Remainder of Site						
Diethyl phthalate	1/14	0.360	0.24	0.135	0.158	0.158
Di-n-butyl phthalate	1/14	1.70	1.30	0.716	0.824	0.824

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]Micrograms per gram.
[c]Upper confidence limit.
[d]The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (USEPA 1989).
[e]Not applicable.

Table 5-88. Selection of Chemicals of Potential Concern for Soil-related Pathways Based on EPA Region III's Soil Screening Guidance (SWMU 13)

	EPA[a] Region III RBC[b] Screen			
	Residential RBCs (μg/g)[c]			
Chemical	Ingestion	Inhalation	Exposure Point Conc. (μg/g)	Retained as COPC[d]
Hot Spot at TDP-04-13 - Surface Soil				
1,3-Dichlorobenzene	700	80[e]	0.16	No
Chloromethane	49	0.063	0.70	**YES**
Dichlorobenzene (nonspecific)	27[f]	30[g]	3.30	No
Hot Spot at TDP-04-13 - Subsurface Soil				
Diethyl phthalate	6,300	52	60	**YES**
Remainder of Site - Surface Soil				
Chromium	39	140	12.4	No
Lead	400[h]	NA[i]	13.2	No
Mercury	2.3	0.7	0.044	No
Bis(2-ethylhexyl)phthalate	46	210	10.1	No
Chrysene	88	3.6	0.07	No
Fluoranthene	310	6.8	0.079	No
Phenanthrene	230[j]	5.6[j]	0.067	No
1,1,1-Trichloroethane	700	98	0.119	No
Subsurface Soil - Remainder of Site				
Diethyl phthalate	6,300	52	0.158	No
Di-n-butyl phthalate	780	10	0.824	No

Note.—RBCs were taken directly from the Region III RBC Table (USEPA 1995), except as noted in the footnotes. Values for noncarcinogens are 1/10 of the Region III RBC.

[a]U.S. Environmental Protection Agency.
[b]Risk-based concentrations.
[c]Micrograms per gram.
[d]Chemicals of potential concern.
[e]Calculated according to Region III guidance (USEPA 1995).
[f]Value for 1,4-Dichlorobenzene.
[g]Value for 1,2-Dichlorobenzene.
[h]OSWER recommended clean-up level for lead in residential soil (USEPA 1994).
[i]Not applicable.
[j]Values for pyrene.

Table 5-89. Site-Wide Surface Soil Exposure Point Concentrations of Chemicals of Potential Concern (SWMU 13)

Chemical	Frequency of Detection[a]	Range of Detected Values (μg/g)	Range of Reporting Limits (μg/g)	Arithmetic Mean Concentration (μg/g)	95% UCL Concentration (μg/g)	Exposure Point Concentration[b] (μg/g)
Chloromethane	1/15	0.70	0.48	0.50	0.52	0.52

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).

5.3.4.2 *Selection of Chemicals of Potential Concern–Air*

For all receptors with the exception of the construction worker, the air pathway (i.e., inhalation of particulates) is evaluated on a SWMU-wide basis rather than by area of concern. Air emissions of SWMU-related chemicals were assumed to occur by entrainment from wind erosion of particulate-bound COPCs. With entrainment, it is assumed that small amounts of the organic compounds or heavy metals become airborne and adsorbed onto the surface of dust particles.

A volatilization emission analysis was performed (SEC Donahue 1992b) using a volatilization release estimation equation designed for chemicals spilled or incorporated into soils (USEPA 1988a). Results from this analysis indicated negligible air quality impacts derived from volatilization releases from SWMUs located at TEAD. In addition, results from previous modeling conducted for adjacent sites with similar VOC concentrations revealed insignificant releases (SEC Donahue 1992b).

For current and future on-site receptors, COPCs retained for the soil pathways were used to evaluate exposures from air. For current off-site receptors, exposure point concentrations generated for COPCs retained for the on-site soil pathways were modeled using SCREEN2 to estimate the air quality impacts at selected sites surrounding TEAD. To maintain a health-protective approach, the RME EPC for children was used as the input soil concentration to the model. Off-site air concentrations generated by the model were screened against USEPA Region III Risk-Based Concentrations guidance to verify the negligible contribution of this pathway. SCREEN2 is a single-source, screening-level model that has algorithms to estimate air quality impacts associated with air sources. For a complete description of the SCREEN2 model and associated results, see Appendix N. As shown in Table 5-90, based on comparison to air RBC, no COPCs were retained for quantitative off-site evaluation.

5.3.4.3 *Selection of the Chemicals of Potential Concern—Groundwater*

The selection of COPCs for the groundwater exposure pathways consist of a two-phase modeling approach. Initially, the *maximum* concentration of each analyte detected in either surface or subsurface soil was compared to the Region III soil-to-groundwater RBC. One-tenth of the value was used for noncarcinogens. If the maximum concentration of a chemical exceeded the soil-to-groundwater RBC, the chemical was selected for vadose zone modeling (Table 5-91). The modeled break-through concentration in groundwater for these chemicals was then compared to the Region III tap water RBCs, with one-tenth of the value used for noncarcinogens. In addition, the modeled break-through time was compared to the 100-year cut-off period as described in Section 2.7.2. A chemical that reached the water table within 100 years *and* had a modeled break-through concentration that exceeded the Region III tap water RBC (one-tenth of the value for noncarcinogens) was retained for further vadose-

Table 5-90. *Selection of Chemicals of Potential Concern for Off-site Air-related Pathways Based on EPA Region III's Risk-Based Concentration Screening Guidance (SWMU 13)*

		EPA Region III Risk-Based Concentration[a] Screen ($\mu g/m^3$)[b]					
Chemical	**RME SWMU-wide Soil Exposure Point Conc. (mg/kg)[c]**	**Exposure Point Conc. at Property Line**	**Exposure Point Conc. at Grantsville**	**Exposure Point Conc. at Tooele**	**Exposure Point Conc. at Stockton**	**Ambient Air RBC**	**Retained as off-site COPC[d]?**
Chloromethane	0.0032	0.00000015	0.000000079	0.000000013	0.000000019	0.99	No

[a]Values for noncarcinogens are 1/10th of the Region III RBC (USEPA 1996).
[b]Micrograms per cubic meter.
[c]Milligrams per kilogram.
[d]Chemicals of potential concern

Table 5-91. Selection of COPCs for Groundwater Exposure Pathways (SMWU 13)

Chemical	Maximum Above Background (μg/g)[a]	Depth	Soil-to-GW[b] RBC[c] (μg/g)	Selected for Vadose Zone Modeling?	Reached Water Table Within 100 Years	Model Output: Break-Through Point Concentration in Ground Water (mg/L)[d]	Tap Water RBC (mg/L)	Selected as COPC[e] for Groundwater ?
1,3-Dichlorobenzene	0.16	Surface	0.6[f]	No	---	---	---	---
Chloromethane	0.7	Surface	0.0066	YES	YES	0.0545	.0014	YES
Dichlorobenzene	3.3	Surface	0.6[g]	YES	No	0.385	.00044[g]	No
Diethyl phthalate	60	Surface	11	YES	YES	5.9	2.900	YES
Chromium	26.5	Surface	1.9	YES	No	1.01	.018	No
Lead	23	Surface	15[f]	YES	No	0.15	.015[h]	No
Mercury	0.069	Surface	0.3[f]	No	---	---	---	---
bis(2-Ethylhexyl)phthalate	20	Surface	11	YES	No	0.0381	.0048	No
Chrysene	0.088	Surface	1.0	No	---	---	---	---
Fluoranthene	0.091	Surface	98	No	---	---	---	---
Phenanthrene	0.074	Surface	140[i]	No	---	---	---	---
1,1,1-Trichloroethane	0.21	Surface	0.09	YES	No	0.0354	0.130	No
Di-n-butyl phthalate	1.7	Subsurface	12	No	---	---	---	---

Note.—RBCs were taken directly from the Region III RBC Table except as indicated in the footnotes.
[a]Micrograms per gram.
[b]Groundwater.
[c]Risk-based concentrations.
[d]Milligrams per liter.
[e]Chemicals of potential concern.
[f]alculated according to Region III guidance (USEPA 1995).
[g]Value for 1,4-dichlorobenzene.
[h]Action level for lead (USEPA 1995).
[i]Value for pyrene.

saturated zone modeling to on- and off-site hypothetical receptors as described in Section 2.7.2. For this second phase of modeling, the *average* surface and subsurface soil concentration was used to calculate the initial pore water concentration at the site. Again, the vadose-saturated zone modeling results were compared to the Region III tap water RBCs, with one-tenth for noncarcinogens. If the chemical still failed to meet the 100-year break-through criteria *and* exceeded the Region III tap water RBC, it was retained for quantitative risk assessment. As shown in Table 5-91, chloromethane, dichlorobenzene, diethyl phthalate, chromium, lead, bis(2-ethylhexyl)phthalate, and 1,1,1-trichloroethane were retained for vadose zone modeling.

5.3.4.3.1 ***Vadose Zone Model Results***. The soil screening described in the previous sections indicated that seven COPCs should be evaluated using the soil-vadose-zone-groundwater-screening model at SWMU 13. These COPCs consist of the two metals and five organic compounds indicated in Table 5-92. The vadose-zone modeling set-up procedures are described in detail in Section 2.7.2 of this report. This section defines the site-specific parameters and presents the vadose-zone modeling results.

The SWMU 13 site-specific input parameters are defined as the thickness of the vadose-zone (H cm), the area of contamination (CA m^2), and the thickness of the contaminated zone (H cont, cm). These input parameters, along with the COPC chemical-specific parameters are used as the input for the GWM-1 and MULTIMED models. All of the GWM-1 spreadsheets for SWMU 13 are shown in Appendix K. The site-specific parameters for SWMU 13 are as follows:

H = 8,200 cm

CA = 119,000 m^2

H cont = 365 cm

Other key COPC-specific parameters—the distribution coefficient (Kd), the maximum observed soil concentration (Tc), the initial pore water concentration (C_{init}), and the plume pulse duration (p.d.)—are also shown in Appendix K. All of the GWM-1 spreadsheets associated with the SWMU-specific COPCs are in Appendix K along with the MULTIMED output concentrations. Table 5-92 summarizes these COPC-specific parameters and shows the MULTIMED output for COPC break-through time (time after leaching starts, that the leading edge of the COPC plume reaches the top of the water table) along with the COPC estimated concentration at the time that breakthrough occurs. One key to interpreting these estimates is that the pore water concentration was determined by starting with the *maximum* observed soil concentration measured at the site (see Table 5-91) and calculating the *maximum* concentration available for the pore water solution by soil-water partitioning. As explained in Section 2.7.2, the equation used is very dependent on Kd and does not take into account mineral solubility and equilibrium relationships. This is evident by some of the high C_{init} concentrations estimated for several of the COPCs.

Table 5-92. Summary of Break-Through Vadose Zone Modeling Results and Critical I/O GWM-1 and MULTIMED Parameters for SWMU 13

COPC[a] Specific Parameters						
Analyte	**Kd[b]**	**Tc[c] (max) (ppm)[d]**	**C_{leak}[e] (mg/L)[f]**	**Breakthrough Time (yrs)**	**Breakthrough Conc. (mg/L)**	**p.d.[g] (yrs)**
Chromium	1.2	26.5	22.5	800	1.01	82
Lead	4.5	23	5.54	2800	0.15	290
Chloromethane	1	0.7	0.7	63	0.0545	70
Dichlorobenzene	1	3.3	3.3	108	0.385	70
Diethyl Phthalate	1	60	60	78	5.9	70
bis(2-Ethylhexyl) phthalate	50	20	0.443	32500	0.0381	3149
1,1,1-Trichloroethane	1	0.21	0.21	108	0.0354	70

Note.—Site-specific parameters are as follows: vadose zone thickness (H) = 8,200 cm; area of contaminated soil (CA) = 119,000 m^2; thickness of contaminated soil (Hcont) = 365 cm.

[a]Chemicals of potential concern.
[b]Distribution coefficient and is dimensionless.
[c]Maximum observed soil concentration (ppm).
[d]Parts per million.
[e]Pore water concentration at the source as conservatively calculated by GWM-1.
[f]Milligrams per liter.
[g]Pulse duration as calculated by GWM-1.

5.3.4.3.2 *Groundwater COPCs.* As shown in the previous sections and in Table 5-92, the MULTIMED output indicates that within a 100-year time period chloromethane and diethyl phthalate will travel downward through the vadose zone and reach the water table. No other COPCs reach the water table within this period. As discussed in detail in Section 2.7.2, the conservative approach was the bases for the model calculations. Both COPCs estimated to reach the water table within the 100-year period exceed the tap water RBC indicated in Table 5-91.

Table 5-92 illustrates this concept, showing the critical input and output parameters and the estimated break-through time for each COPC. This table also shows the estimated concentration associated with the arrival of the leading edge of the COPC plume at the water table. Again, it should be noted that the break-through time calculation does not take into account the various retardation influences, such as biodegradation, volatilization, absorption, adsorption, and mineral-solution equilibrium relationships.

The compounds chloromethane and diethyl phthalate reach the water table in approximately 63 and 78 years, respectively. The remainder of the COPCs ranged in break-through time from 108 years for 1,1,1-TCE to 32,500 years for bis(2-ethylhexyl) phthalate. Table 5-92 summarizes all of the COPCs at SWMU 13.

To further evaluate the potential for chloromethane and diethylphthalate to affect human health, the saturated zone module of MULTIMED was expanded to estimate the maximum on-site COPC concentration and the maximum off-site concentration at a hypothetical receptor on the northern boundary of TEAD-N. Various input parameters were adjusted to accommodate the saturated zone modeling to the on-site and off-site receptors. These parameters included the aquifer thickness (50 meters), the mixing zone thickness (50 meters), and the initial pore water concentration (set equal to the *average* observed soil concentration). In addition, the hydraulic gradient (0.0058—dimensionless) and distance (8,250 meters) to the off-site receptor were adjusted to represent simulation to the hypothetical receptors at SWMU 13 (see Section 2.7.2). The remaining input parameters were not adjusted. The hydraulic gradient, distance to the off-site receptor and the modeling results are presented in Table 5-93. The on-site receptor exposure point was set to 1 meter from the point that the COPC first reached the water table, thus representing the saturated zone directly underlying the SWMU. Based on the results shown in Table 5-93, chloromethane and diethyl phthalate were selected as groundwater COPCs for future on-site adult resident.

5.3.4.4 *Exposure Assessment*

Exposure is defined as the contact of a receptor with a chemical (USEPA 1989c). Exposure assessment is the estimation of the magnitude, frequency, and duration for each identified route of exposure. The magnitude of an exposure is determined by estimating the amount of chemical available at the receptor exchange boundaries (i.e., lungs, gastrointestinal tract, or skin) during a specified time period.

Table 5-93. Summary of Vadose Zone and Saturated Zone Modeling for SWMU 13 (Using Average Soil Concentrations)

SWMU	Chemical	Tc[a] (avg) ppm[b]	Cinit (mg/L)[c]	Est. Peak On Site Conc. (mg/L)	Est. Peak On Site Time (yrs)	Est. Peak Off Site Conc. (mg/L)	Est. Peak Off Site Time (yrs.)	Est. Hydraulic Gradient	Est. Contaminated Area (m^2)	Est. Distance to Receptor (m)
13	Chloromethane	0.49	0.49	0.1438	123	0.000063	643	0.0058	119,000	8,250
13	Diethyl phthalate	2.1	2.1	0.5953	138	0.00027	683	0.0058	119,000	8,250

[a]Maximum observed soil concentration (ppm).
[b]Parts per million.
[c]Milligrams per liter.

Section 3.1.2 describes the general tasks comprising the exposure assessment. The specific application of these tasks to SWMU 13 is described below.

5.3.4.4.1 *Characterization of Exposure Setting*. The first step in developing exposure scenarios for SWMU 13 was to characterize the site setting in which potential exposures might occur. The characteristics of the site setting influence the types of transport mechanisms and the type of receptor exposure that could occur. The site setting also provides a basis for identifying the potential receptors (either real or, in the case of site redevelopment for alternative use, hypothetical). Both current land use patterns and future land use patterns were examined as part of the characterization.

Current Land Use. As is true for other areas of TEAD-N, public access to SWMU 13 is controlled, thereby precluding transient exposure. SWMU 13 is located in the south central portion of TEAD-N and will remain part of the depot mission for the foreseeable future. Data were not available on current use patterns of the Tire Disposal Area.

Based on the above information, potential receptors under current land use were defined as the SWMU-specific laborers and security personnel (e.g., individuals with job descriptions that call for repeated, light to moderate labor in the general vicinity of SWMU 13 and staff assigned to maintenance of the perimeter or security personnel that repeatedly work in the vicinity of SWMU 13).

Because other potential receptors would be exposed only intermittently to SWMU 13, SWMU-specific laborers and security personnel were the only on-site receptors evaluated quantitatively as a current-use scenario. This approach provides a series of upper-bound estimates.

Cattle grazing is permitted at TEAD-N, with grazing allotments competitively bid and leased every 5 years to a single rancher. The current lease is up for rebid in 1996. Grazing at TEAD-N typically occurs between October 15 and May 31, with calving taking place in January. The calves remain at the facility until May 31 when they are either moved to feedlots or to other grazing areas. The calves typically do not return to TEAD-N after their initial exposure, and they are eventually sold as slaughter cattle for human consumption. Distribution is through regional and national distribution networks. The cows are normally utilized as breeding stock and may or may not return to the site during consecutive years. The current lessee brings approximately 1,000 head, mostly heifers, to winter pasture at TEAD-N and maintains summer pasture in Idaho (M. Walker, personal communication with Rust E&I, 1994).

SWMU 13 is one of several SWMUs on one grazing allotment currently under lease. Consumption of beef grazed on the allotment of which SWMU 13 is a part is evaluated in a separate section (Section 5.7) of the risk assessment.

Future Land Use. No change in current use is planned for the Tire Disposal Area. Current BRAC recommendations retain SWMU 13's function as part of the depot's mission. However, should the mission of TEAD-N change in the future, two additional exposure scenarios unique to planned or potential future use of SWMU 13 were developed (see Section 3.0):

- Skilled laborers—Individuals assigned to short-term construction in the vicinity of SWMU 13 during potential redevelopment.

- Inhabitants of an on-site residence(s)—Individuals who live in residences established at the time that depot property should ever be transferred for redevelopment.

5.3.4.4.2 ***Characterization of Potential Exposure Pathways***. An exposure pathway is the route COPCs take to reach potential receptors. Section 3.1.2.1 and 3.1.2.2 describe the methodology for characterization of exposure pathways. This methodology was then applied to SWMU 13. The following sections describe the potential exposure pathways associated with SWMU 13 for the current and future land use scenarios.

Current Land Use. Currently, the majority of laborers at TEAD-N work 10-hour days with 4-day weeks. A total of 4 weeks off a year for vacation, holidays, and sick leave yields 192 days per year on the job. It is assumed that a laborer could be at any specific SWMU from 2 (CTE) to 10 (RME) hours per day and will incidentally ingest, inhale, or become in contact with surface soil through worker-related activities. Military personnel are rotated on assignment an average of every 3 years (S. Culley, personal communication with Rust E&I, 1994). If a laborer is a civilian, the length of assignment could be expected to range as high as 25 years. It is assumed that all of the exposure is from outdoor tasks or activities. Specific parameters relating to ingestion, contact, and ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

Future Land Use. No change in current use is planned for the Tire Disposal Area. Current BRAC recommendations retain SWMU 13's function as part of the depot's mission. However, should the mission of TEAD-N change in the future, land associated with SWMU 13 may be used at some future time for residential development. Based on this assumption, the future on-site adult and child resident are evaluated for the future land use scenario.

For the future on-site adult resident, it was assumed that at least one parent would spend much of his or her time away from home in activities such as working at another location, household errands, personal care (e.g., medical/dental appointments), or leisure activities. Based on this assumption, the total estimated time an adult will spend at home is approximately 15 to 19 hours per day during which time he or she may incidentally ingest, inhale, or come in contact with surface soil while conducting activities such as gardening, mowing, or outdoor sports. It is also expected that the future on-site resident will grow and harvest vegetables and fruits from a home garden. For children and adolescents ages 0 to 18, time activity patterns indicate

that they spend an average of approximately 30 hours per week away from home to attend school or day care. The total time a child spends at home, averaged over a 7-day week, is approximately 20 hours per day. It is assumed that residents spend 2 (RME) to 4 (CTE) weeks away from home on vacation or long holiday weekends. Therefore, the exposure frequency in real time is 335 days per year (CTE) to 350 days per year (RME). Because the contact rate for ingestion and dermal exposure is in daily units, the exposure frequency for these pathways is prorated into 24-hour-day equivalents. This ranges from 216 days per year (CTE adult) to 276 days per year (CTE child) and from 273 days per year (RME adult) to 288 days per year (RME child) (see Appendix L). Years spent at one residence for the adult/child range from 8 (CTE) to 30 (RME) years based on studies compiled by the USEPA (1989c) and AIHC (1994). Specific parameters relating to ingestion, contact, ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

Based on the continued industrial future usage of SWMU 13, it is possible that industrial construction may be conducted to increase the capacity of the military operations at TEAD-N. For these reasons, the future construction worker scenario was evaluated. It is assumed that a construction company could be contracted for a work period ranging from 1 to 3 years and a single worker could be at the site conducting activities outdoors from 2 to 4 months of the year. It is assumed that a worker works as much as 8 to 10 hours per day and may incidentally ingest, inhale, or come in contact with subsurface soil through construction-related activities. Specific parameters relating to ingestion, contact, ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

5.3.4.4.3 ***Exposure Point Concentrations.*** The EPC is defined as the concentration of a COPC in an exposure medium that will be contacted over a real or hypothetical exposure duration. EPCs at SWMU 13 were evaluated for current and future land use. Estimation of EPCs is fully described in Appendix L. For brevity, only information specific to SWMU 13 is presented in the following sections.

As discussed in Sections 5.3.4.1 and 5.3.4.2, two areas of concern were evaluated for SWMU 13. Based on the screening methodology, EPCs were estimated for surface and subsurface soils for only one area of concern—Hot Spot at TDP-94-13. In addition to the hot spot, EPCs were estimated for the SWMU as a whole.

Current Land Use. EPCs for surface soil ingestion and dermal contact by the SWMU 13 personnel were estimated for the CTE and RME exposure scenario from Phase I and II RI data. Because the duties of on-site personnel vary, EPCs were developed for each area of concern and the SWMU as a whole to encompass all potential exposure scenarios for this receptor.

EPCs in air for on-site personnel were estimated using USEPA's SCREEN2 model. Air emissions were not evaluated for each specific area of concern. It was assumed that the SWMU, as a whole, was the main source for air emission generation for all on-site receptors.

Details of the estimation of emission rates from surface soils and dispersion modeling are described in Appendix N. Tables 5-94 and 5-95 list EPCs for on-site personnel associated with SWMU 13.

Future Land Use. EPCs for subsurface soil ingestion and dermal contact by hypothetical future on-site construction workers at SWMU 13 were estimated using the same methods as those used for the on-site personnel under the current land use. However, it was assumed that the construction projects would be limited in size, therefore, potential exposure pathways are only evaluated for the area of concern and not for the SWMU as a whole (Table 5-94).

EPCs for surface soil ingestion, dermal contact, produce and groundwater ingestion by hypothetical future on-site residents at SWMU 13 were estimated using methods described in Appendix L. The EPCs are given in Tables 5-94 and 5-96. EPCs for inhalation of particulates were modeled, as described in Appendix N, for the hypothetical on-site construction worker and on-site resident (see Appendix L).

5.3.4.4.4 ***Estimation of Chemical Intakes***. The exposure models described in detail in Appendix L together with EPCs listed in Tables 5-94 through 5-96 were used to estimate intake for the potential exposure scenarios. Note that averaging time differs for carcinogens and noncarcinogens. Estimates of exposure intakes are given in Tables 5-97 through 5-107 of Section 5.3.4.5.

5.3.4.5 *Toxicity Assessment*

Information of the toxicological effects of carcinogenic and systemic toxicants are summarized in Appendix M. This toxicity assessment includes brief toxicity profiles on data listed in USEPA's IRIS database and published in HEAST (USEPA 1994c). These profiles describe the acute, chronic, and carcinogenic health effects associated with SWMU-related chemicals. Toxicity values for COPCs associated with areas of concern for SWMU 13 are summarized in Tables 5-97 through 5-107 of the following section.

5.3.4.6 *Risk Characterization*

This section provides a characterization of the potential health risks associated with the intake of chemicals associated with the Hot Spot at TDP-94-13 area of concern and SWMU 13 as a whole. The risk characterization compares estimated potential ILCRs with reasonable levels of risk for potential carcinogens (see Section 3.1.4.1), and the estimated daily intake of systemic toxicants with appropriate reference levels. Some carcinogenic chemicals may also pose a systemic hazard, and these potential hazards are characterized as for other systemic toxicants. Each of the areas associated with SWMU 13 are discussed separately below.

Table 5-94. Adult Exposure Point Concentrations for the Hot Spot at TDP-94-13 Area of Concern Associated with SWMU 13

Chemical	Exposure Point Concentration	
	CTE	RME
Current Land Use		
Surface Soil (mg/kg)		
Chloromethane	0.0065	0.0031
Air Emissions ($\mu g/m^3$)		
Chloromethane	0.000000228	0.000000109
Future Land Use [(a)]		
Surface Soil (mg/kg)		
Chloromethane	0.0024	0.0026
Air Emissions from Surface Soil ($\mu g/m^3$)		
Chloromethane	0.0000000856	0.0000000904
Subsurface Soil (mg/kg)		
Diethyl Phthalate	0.71	4.43
Air Emissions from Subsurface Soil ($\mu g/m^3$)		
Diethyl Phthalate	0.0026	0.0162
Groundwater (mg/L)		
Chloromethane	0.14	0.14
Diethyl Phthalate	0.60	0.60
Tubers/Fruits (mg/kg)		
Chloromethane	0.20	0.21
Leafy Vegetables (mg/kg)		
Chloromethane	0.0056	0.0060

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Table 5-95. Adult Exposure Point Concentrations for SWMU 13 as a Whole

Chemical	Exposure Point Concentration CTE	Exposure Point Concentration RME
Current Land Use		
Surface Soil (mg/kg)		
Chloromethane	0.0048	0.0023
Air Emissions ($\mu g/m^3$)		
Chloromethane	0.000000228	0.000000109

Table 5-96. Child Exposure Point Concentrations for the Hot Spot at TDP-94-13 Area of Concern Associated with SWMU 13

Chemical	Exposure Point Concentration CTE	Exposure Point Concentration RME
Future Land Use [a]		
Surface Soil (mg/kg)		
Chloromethane	0.0024	0.0043
Air Emissions ($\mu g/m^3$)		
Chloromethane	0.0000000856	0.000000152
Tubers/Fruits (mg/kg)		
Chloromethane	0.20	0.35
Leafy Vegetables (mg/kg)		
Chloromethane	0.0056	0.0099

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Table 5-97. Summary of Potential Carcinogenic Risk Results for the Current/Future On-site Laborer for SWMU 13 (Hot Spot at TDP-94-13)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) (mg/kg-day)$^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Chloromethane	6.5E-03	6.2E-13	1.3E-02	8.0E-15	
			Pathway Total:	8.0E-15	62%
Dermal Contact with Surface Soil					
Chloromethane	6.5E-03	3.1E-13	1.6E-02	5.0E-15	
			Pathway Total:	5.0E-15	38%
Inhalation of Particulates					
Chloromethane	2.3E-10	1.0E-14	6.3E-03	6.6E-17	
			Pathway Total:	6.6E-17	1%
			Total CTE ILCR:	1.3E-14	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Chloromethane	3.1E-03	2.4E-10	1.3E-02	3.1E-12	
			Pathway Total:	3.1E-12	41%
Dermal Contact with Surface Soil					
Chloromethane	3.1E-03	2.7E-10	1.6E-02	4.4E-12	
			Pathway Total:	4.4E-12	59%
Inhalation of Particulates					
Chloromethane	1.1E-10	1.2E-12	6.3E-03	7.6E-15	
			Pathway Total:	7.6E-15	0%
			Total RME ILCR:	7.5E-12	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

Table 5-98. Summary of Potential Carcinogenic Risk Results for the Future On-site Adult Resident for SWMU 13 (Hot Spot at TDP-94-13)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Chloromethane	2.4E-03	2.1E-11	1.3E-02	2.7E-13	
			Pathway Total:	2.7E-13	0.03%
Dermal Contact with Surface Soil					
Chloromethane	2.4E-03	1.1E-11	1.6E-02	1.7E-13	
			Pathway Total:	1.7E-13	0.02%
Inhalation of Particulates					
Chloromethane	8.6E-11	3.1E-13	6.3E-02	2.0E-14	
			Pathway Total:	2.0E-14	NA[d]
Ingestion of Leafy Vegetables					
Chloromethane	5.6E-03	8.3E-08	1.3E-02	1.1E-09	
			Pathway Total:	1.1E-09	0.85%
Ingestion of Tubers and Fruits					
Chloromethane	2.0E-01	9.8E-06	1.3E-02	1.3E-07	
			Pathway Total:	1.3E-07	99.11%
			Total CTE ILCR:	1.3E-07	100.00%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Chloromethane	2.6E-03	5.4E-10	1.3E-02	7.0E-12	
			Pathway Total:	7.0E-12	0.05%
Dermal Contact with Surface Soil					
Chloromethane	2.6E-03	6.3E-10	1.6E-02	1.0E-11	
			Pathway Total:	1.0E-11	0.07%
Inhalation of Particulates					
Chloromethane	9.0E-11	1.7E-12	6.3E-03	1.1E-14	
			Pathway Total:	1.1E-14	NA
Ingestion of Leafy Vegetables					
Chloromethane	6.0E-03	1.2E-06	1.3E-02	1.5E-08	
			Pathway Total:	1.5E-08	0.85%
Ingestion of Tubers and Fruits					
Chloromethane	2.1E-01	1.4E-04	1.3E-02	1.8E-06	
			Pathway Total:	1.8E-06	99.04%
			Total RME ILCR:	1.8E-06	100.00%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-99. Summary of Potential Carcinogenic Risk Results for the Future On-site Adult Resident from Ingestion of Groundwater for SWMU 13 (Hot Spot at TDP-94-13)

Chemical	Exposure Point Concentration (mg/L)	Daily Carcinogenic Intake(a) (mg/kg-day)	Carcinogenic Slope Factor(b) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Groundwater					
Chloromethane	1.4E-01	1.8E-04	1.3E-02	2.3E-06	
Diethyl Phthalate	6.0E-01	NA(c)	NA	NA	
			Total CTE ILCR:	2.3E-06	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Groundwater					
Chloromethane	1.4E-01	1.2E-03	1.3E-02	1.6E-05	
Diethyl Phthalate	6.0E-01	NA	NA	NA	
			Total RME ILCR:	1.6E-05	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.

[b]See Appendix M for sources and methodology of toxicity values.

[c]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-100. Summary of Potential Carcinogenic Risk Results for the Future On-site Child Resident for SWMU 13 (Hot Spot at TDP-04-13)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) (mg/kg-day)$^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Chloromethane	2.4E-03	9.5E-11	1.3E-02	1.2E-12	
			Pathway Total:	1.2E-12	0%
Dermal Contact with Surface Soil					
Chloromethane	2.4E-03	1.8E-11	1.6E-02	2.8E-13	
			Pathway Total:	2.8E-13	0%
Inhalation of Particulates					
Chloromethane	8.6E-11	1.6E-12	6.0E-03	9.6E-15	
			Pathway Total:	9.6E-15	NA(d)
Ingestion of Leafy Vegetables					
Chloromethane	5.6E-03	1.4E-07	1.3E-02	1.8E-09	
			Pathway Total:	1.8E-09	1%
Ingestion of Tubers and Fruits					
Chloromethane	2.0E-01	1.6E-05	1.3E-02	2.1E-07	
			Pathway Total:	2.1E-07	99%
			Total CTE ILCR:	2.1E-07	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Chloromethane	4.3E-03	1.9E-09	1.3E-02	2.5E-11	
			Pathway Total:	2.5E-11	0%
Dermal Contact with Surface Soil					
Chloromethane	4.3E-03	4.3E-10	1.6E-02	6.9E-12	
			Pathway Total:	6.9E-12	0%
Inhalation of Particulates					
Chloromethane	1.5E-10	4.6E-12	6.0E-03	2.8E-14	
			Pathway Total:	2.8E-14	NA
Ingestion of Leafy Vegetables					
Chloromethane	9.9E-03	1.3E-06	1.3E-02	1.7E-08	
			Pathway Total:	1.7E-08	1%
Ingestion of Tubers and Fruits					
Chloromethane	3.5E-01	1.5E-04	1.3E-02	1.9E-06	
			Pathway Total:	1.9E-06	99%
			Total RME ILCR:	2.0E-06	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-101. Summary of Potential Carcinogenic Risk Results for the Current/Future On-Site Laborer for SWMU 13 as a Whole

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Chloromethane	4.8E-03	4.6E-13	1.3E-02	5.9E-15	
			Pathway Total:	5.9E-15	61%
Dermal Contact with Surface Soil					
Chloromethane	4.8E-03	2.3E-13	1.6E-02	3.7E-15	
			Pathway Total:	3.7E-15	38%
Inhalation of Particulates					
Chloromethane	2.3E-10	1.0E-14	6.3E-03	6.6E-17	
			Pathway Total:	6.6E-17	1%
			Total CTE ILCR:	9.7E-15	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Chloromethane	2.3E-03	1.8E-10	1.3E-02	2.3E-12	
			Pathway Total:	2.3E-12	41%
Dermal Contact with Surface Soil					
Chloromethane	2.3E-03	2.0E-10	1.6E-02	3.3E-12	
			Pathway Total:	3.3E-12	59%
Inhalation of Particulates					
Chloromethane	1.1E-10	1.2E-12	6.3E-03	7.6E-15	
			Pathway Total:	7.6E-15	0%
			Total RME ILCR:	5.5E-12	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

Table 5-102. Summary of Potential Systemic Effects for the Current/Future On-site Laborer for SWMU 13 (Hot Spt at TDP-94-13)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Chloromethane	6.5E-03	1.5E-11	4.0E-03	3.9E-09	
			Pathway Total:	3.9E-09	89%
Dermal Contact with Surface Soil					
Chloromethane	6.5E-03	7.7E-12	1.6E-02	4.8E-10	
			Pathway Total:	4.8E-10	11%
Inhalation of Particulates					
Chloromethane	2.3E-10	NA(d)	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	4.4E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Chloromethane	3.1E-03	7.1E-10	4.0E-03	1.8E-07	
			Pathway Total:	1.8E-07	77%
Dermal Contact with Surface Soil					
Chloromethane	3.1E-03	8.2E-10	1.6E-02	5.1E-08	
			Pathway Total:	5.1E-08	23%
Inhalation of Particulates					
Chloromethane	1.1E-10	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	2.3E-07	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-103. Summary of Potential Systemic Effects for the Future On-site Adult Resident for SWMU 13 (Hot Spot at TDP-94-13)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Chloromethane	2.4E-03	2.0E-10	4.0E-03	4.9E-08	
			Pathway Total:	4.9E-08	0%
Dermal Contact with Surface Soil					
Chloromethane	2.4E-03	9.9E-11	1.6E-02	6.2E-09	
			Pathway Total:	6.2E-09	0%
Inhalation of Particulates					
Chloromethane	8.6E-11	NA[d]	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Chloromethane	5.6E-03	7.8E-07	4.0E-03	2.0E-04	
			Pathway Total:	2.0E-04	1%
Ingestion of Tubers and Fruits					
Chloromethane	2.0E-01	9.2E-05	4.0E-03	2.3E-02	
			Pathway Total:	2.3E-02	99%
			Total CTE HI:	2.3E-02	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Chloromethane	2.6E-03	1.3E-09	4.0E-03	3.4E-07	
			Pathway Total:	3.4E-07	0%
Dermal Contact with Surface Soil					
Chloromethane	2.6E-03	1.6E-09	1.6E-02	9.8E-08	
			Pathway Total:	9.8E-08	0%
Inhalation of Particulates					
Chloromethane	9.0E-11	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Chloromethane	6.0E-03	2.9E-06	4.0E-03	7.3E-04	
			Pathway Total:	7.3E-04	1%
Ingestion of Tubers and Fruits					
Chloromethane	2.1E-01	3.4E-04	4.0E-03	8.6E-02	
			Pathway Total:	8.6E-02	99%
			Total RME HI:	8.7E-02	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-104. Summary of Potential Systemic Effects for the Future On-site Adult Resident from Ingestion of Groundwater for SWMU 13 (Hot Spot at TDP-94-13)

Chemical	Exposure Point Concentration (mg/L)	Daily Noncarcinogenic Intake[a] (mg/kg-day)	Chronic RfD[b] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Groundwater					
Chloromethane	1.4E-01	1.7E-03	4.0E-03	4.1E-01	
Diethyl Phthalate	6.0E-01	6.8E-03	8.0E-01	8.6E-03	
			Total CTE HI:	4.2E-01	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Groundwater					
Chloromethane	1.4E-01	3.0E-03	4.0E-03	7.5E-01	
Diethyl Phthalate	6.0E-01	1.2E-02	8.0E-01	1.5E-02	
			Total RME HI:	7.6E-01	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.
[b]See Appendix M for sources and methodology of toxicity values.

Table 5-105. Summary of Potential Systemic Effects for the Future On-site Child Resident for SWMU 13 (Hot Spot at TDP-94-13)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Chloromethane	2.4E-03	8.9E-10	4.0E-03	2.2E-07	
			Pathway Total:	2.2E-07	0%
Dermal Contact with Surface Soil					
Chloromethane	2.4E-03	1.7E-10	1.6E-02	1.0E-08	
			Pathway Total:	1.0E-08	0%
Inhalation of Particulates					
Chloromethane	8.6E-11	NA(d)	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Chloromethane	5.6E-03	1.3E-06	4.0E-03	3.2E-04	
			Pathway Total:	3.2E-04	1%
Ingestion of Tubers and Fruits					
Chloromethane	2.0E-01	1.5E-04	4.0E-03	3.7E-02	
			Pathway Total:	3.7E-02	99%
			Total CTE HI:	3.8E-02	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Chloromethane	4.3E-03	8.0E-09	4.0E-03	2.0E-06	
			Pathway Total:	2.0E-06	0%
Dermal Contact with Surface Soil					
Chloromethane	4.3E-03	1.8E-09	1.6E-02	1.1E-07	
			Pathway Total:	1.1E-07	0%
Inhalation of Particulates					
Chloromethane	1.5E-10	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Chloromethane	9.9E-03	5.3E-06	4.0E-03	1.3E-03	
			Pathway Total:	1.3E-03	1%
Ingestion of Tubers and Fruits					
Chloromethane	3.5E-01	6.2E-04	4.0E-03	1.6E-01	
			Pathway Total:	1.6E-01	99%
			Total RME HI:	1.6E-01	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-106. Summary of Potential Systemic Effects for the Future Construction Worker for SWMU 13 (Hot Spot at TDP-94-13)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Subsurface Soil					
Diethyl Phthalate	7.1E-01	3.9E-07	8.0E+00	4.9E-08	
			Pathway Total:	4.9E-08	100%
Dermal Contact with Subsurface Soil					
Diethyl Phthalate	7.1E-01	NA[d]	NA	NA	
			Pathway Total:	NA	N
Inhalation of Particulates					
Diethyl Phthalate	2.6E-06	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	4.9E-08	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Subsurface Soil					
Diethyl Phthalate	4.4E+00	1.1E-05	8.0E+00	1.4E-06	
			Pathway Total:	1.4E-06	100%
Dermal Contact with Subsurface Soil					
Diethyl Phthalate	4.4E+00	NA	NA	NA	
			Pathway Total:	NA	NA
Inhalation of Particulates					
Diethyl Phthalate	1.6E-05	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	1.4E-06	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-107. Summary of Potential Systemic Effects for the Current/Future On-site Laborer for SWMU 13 as a Whole

Chemical	Exposure Point Concentration (mg/kg)[(a)]	Daily Noncarcinogenic Intake[(b)] (mg/kg-day)	Chronic RfD[(c)] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Chloromethane	4.8E-03	1.1E-11	4.0E-03	2.9E-09	
			Pathway Total:	2.9E-09	89%
Dermal Contact with Surface Soil					
Chloromethane	4.8E-03	5.7E-12	1.6E-02	3.6E-10	
			Pathway Total:	3.6E-10	11%
Inhalation of Particulates					
Chloromethane	2.3E-10	NA[(d)]	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	3.2E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Chloromethane	2.3E-03	5.2E-10	4.0E-03	1.3E-07	
			Pathway Total:	1.3E-07	77%
Dermal Contact with Surface Soil					
Chloromethane	2.3E-03	6.1E-10	1.6E-02	3.8E-08	
			Pathway Total:	3.8E-08	23%
Inhalation of Particulates					
Chloromethane	1.1E-10	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	1.7E-07	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

5.3.4.6.1 *Characterization of Potential Carcinogenic Risks*

Hot Spot at TDP-94-13 Area of Concern. The general process used to select the COPCs associated with the Hot Spot at TDP-94-13 area of concern is described in Section 3.1.1. COPC selection for SWMU 13 is described in Section 5.3.4.2. Chloromethane, a possible human carcinogen, is the only COPC identified for current land use scenarios. For future land use scenarios, chloromethane (a possible human carcinogen) and diethyl phthalate are the COPCs. Chloromethane is the only COPC for future resident exposures to contaminated media, including surface soil, air emissions from surface soil, tubers/fruits, and leafy vegetables. Diethyl phthalate is the only COPC for future construction worker exposures to contaminated media, including subsurface soil and air emissions from subsurface soil. These COPCs and their associated media are presented in Tables 5-94 and 5-95.

Current/Future On-site Laborer. The cumulative ILCR for all pathways does not exceed the lower bound of the target risk range. Estimated ILCRs for all pathways range from 7.5E-12 and 1.3E-14 for the RME and CTE scenarios, respectively, as summarized in Table 5-97. The sole contributor to this carcinogenic risk estimate is chloromethane.

Future On-site Adult Resident. The cumulative ILCR for all pathways are within or below the target risk range. Estimated ILCRs for all pathways range from 1.8E-06 to 1.3E-07 for the RME and CTE scenarios, respectively, as summarized in Table 5-98. The driving pathway is ingestion of produce, which contributes greater than 99 percent of the total ILCR.

Incremental lifetime cancer risk attributed to ingestion of produce, leafy vegetables, tubers and fruits by adults, results in an estimated ILCR of 1.8E-06 and 1.3E-07 using RME and CTE parameters, respectively. For the remaining pathways evaluated, ingestion and dermal contact with surface soil and inhalation of particulates, none have ILCRs above the lower limit of the target risk range. ILCRs for these pathways range from 1.0E-11 to 2.0E-14 for the RME and CTE scenarios, respectively. The only contributor to the estimated risk is chloromethane, which is the sole COPC for this media.

Evaluated separately from the soil and air pathways, ingestion of groundwater by potential on-site adult residents results in a ILCR of 1.6E-05 to 2.3E-06 for the RME and CTE scenario (see Table 5-99). However, it should be noted that environmental degradation of chloromethane and diethyl phthalate was not taken into account when estimating the EPC. For these reasons, the RME and CTE ILCRs for the ingestion of groundwater pathway are very likely to be an overestimate of risk.

Future On-site Child Resident. The cumulative ILCR for all pathways are within or below the target risk range. Estimated ILCRs for all pathways range from 2.0E-06 to 2.1E-07 for the RME and CTE scenarios, respectively, as summarized in Table 5-100. The driving pathway is ingestion of produce, which contributes greater than 99 percent of the total ILCR.

Incremental lifetime cancer risk attributed to ingestion of produce, leafy vegetables, tubers and fruits by children, results in an estimated ILCR of 1.9E-06 and 2.1E-07 using RME and CTE

parameters, respectively. For the remaining pathways evaluated, ingestion and dermal contact with surface soil and inhalation of particulates, none has ILCRs above the lower limit of the target risk range. ILCRs for these pathways range from 2.5E-11 to 9.6E-15 for the RME and CTE scenarios, respectively. The only contributor to the estimated risk is chloromethane, which is the sole COPC for this media.

Future Construction Worker. The cumulative ILCR for this receptor was not estimated because the only COPC for this scenario, diethyl phthalate, is not classified as a carcinogen.

SWMU 13 as a Whole. The general process used to select the COPC associated with SWMU 13 as a whole is described in Section 3.1.1. The COPC selection for SWMU 13 is described in Section 5.3.4.2. Chloromethane, a possible human carcinogen, is the only COPC identified for current land use scenarios. This COPC and associated media are presented in Table 5-96.

Current/Future On-site Laborer. The cumulative ILCR for all pathways does not exceed the lower bound of the target risk range. Estimated ILCRs for all pathways range from 5.5E-12 and 9.7E-15 for the RME and CTE scenarios, respectively, as summarized in Table 5-101. The sole contributor to these risk estimates is chloromethane.

5.3.4.6.2 *Characterization of Potential Systemic Effects*

Hot Spot at TDP-94-13 Area of Concern. The general process used to select the COPC for the Hot Spot at TDP-94-13 area of concern is described in Section 3.1.1. The COPC selection for SWMU 13 is described in Section 5.3.4.2. Chloromethane is the only COPC for media, including surface soil, air emissions from surface soil, tubers/fruits, and leafy vegetables. Diethyl phthalate is the only COPC for media, including subsurface soil and air emissions from subsurface soil. Systemic effects were estimated for all pathways with the exception of the inhalation pathway. Noncarcinogenic toxicity information is currently not available for COPCs associated with SWMU 13. These COPC and their associated media are presented in Tables 5-94 and 5-95.

Current/Future On-site Laborer. As summarized in Table 5-102, the summed HI for all pathways does not exceed unity (one). The summed HIs range from 2.3E-07 to 4.4E-09 for the RME and CTE scenarios, respectively.

Future On-site Adult Resident. As summarized in Table 5-103, the summed HI for all pathways does not exceed unity (one). The summed HIs range from 8.7E-02 to 2.3E-02 for the RME and CTE scenarios, respectively.

Evaluated separately from the soil and air pathways, ingestion of groundwater by potential on-site adult residents results in an HI of 7.6E-01 to 4.2E-01 for the RME and CTE scenario (Table 5-104). However, it should be noted that environmental degradation of chloromethane and diethyl phthalate was not taken into account when estimating the EPC. For these reasons,

the RME and CTE HIs for the ingestion of groundwater pathway are very likely to be an overestimate of risk.

Future On-site Child Resident. As summarized in Table 5-105, the summed HI for all pathways does not exceed unity (one). The summed HIs range from 1.6E-01 to 3.8E-02 for the RME and CTE scenarios, respectively.

Future Construction Worker. As summarized in Table 5-106, the summed HI for all pathways does not exceed unity (one). The summed HIs range from 1.4E-06 to 4.9E-08 for the RME and CTE scenarios, respectively.

SWMU 13 As a Whole. The general process used to select the COPC associated with SWMU 13 as a whole is described in Section 3.1.1. The COPC selection for SWMU 13 is described in Section 5.2.4.2. For the current land use scenarios, chloromethane is the only identified COPC. Systemic effects were estimated for all pathways with the exception of the inhalation pathway. Noncarcinogenic toxicity information is currently not available for COPCs associated with SWMU 13. Table 5-95 presents this COPC and associated media.

Current/Future On-site Laborer. As summarized in Table 5-107, the summed HI for all pathways does not exceed unity (one). The summed HIs range from 1.7E-07 to 3.2E-09 for the RME and CTE scenarios, respectively.

5.3.4.7 *Risk Assessment Summary and Conclusions*

A baseline risk assessment was conducted for the Tire Disposal Area (SWMU 13) based on Phase I and Phase II RI data. Three current- and future-use scenarios were quantitatively evaluated:

- On-site laborer/security worker
- On-site resident (redevelopment)
- Construction worker (during redevelopment)

For each scenario, an RME and a CTE were evaluated. All scenarios were found to fall within or below the target ranges for tolerable ILCRs and HIs.

Tables 5-108 and 5-109 summarize the RME and CTE ILCRs and HIs for current and future land use scenarios at SWMU 13.

Based on the available analytical data and the above considerations, the risk assessment results indicate that risks to human health from the presence of low levels of hazardous chemicals at SWMU 13 are at acceptable levels when compared with risk-based criteria. No further remedial investigations, based on considerations of human health, are recommended for SWMU 13.

Table 5-108. Summary of CTE Risk Results for SWMU 13

Scenario	Hot Spot at TDP-94-13 HI	Hot Spot at TDP-94-13 ILCR	SWMU as a Whole HI	SWMU as a Whole ILCR
Current Land Use				
On-site Laborer	4.4E-09	1.3E-14	3.2E-09	9.7E-15
Future Land Use				
On-site Adult Resident	2.3E-02	1.3E-07	---	---
On-site Child Resident	3.8E-02	2.1E-07	---	---
Construction Worker	4.9E-08	---	---	---

Table 5-109. Summary of RME Risk Results for SWMU 13

Scenario	Hot Spot at TDP-94-13 HI	Hot Spot at TDP-94-13 ILCR	SWMU as a Whole HI	SWMU as a Whole ILCR
Current Land Use				
On-site Laborer	2.3E-07	7.5E-12	1.7E-07	5.5E-12
Future Land Use				
On-site Adult Resident	8.7E-02	1.8E-06	---	---
On-site Child Resident	1.6E-01	2.0E-06	---	---
Construction Worker	1.4E-06	---	---	---

5.3.5 Conclusions and Recommendations

Metals, SVOCs, and VOCs were analyzed for in surface and subsurface soils at the Tire Disposal Area. Mercury, magnesium, lead, and chromium were the only metals detected at concentrations slightly exceeding their respective background values at SWMU 13. SVOCs detected include fluoranthene, phenanthrene, chrysene, diethyl phthalate, bis(2-ethylhexyl) phthalate, and some unknowns. The majority of SVOCs at the site appear to be limited to the surface and their source is unknown. Small areas of surface staining within the pit may have resulted from leaking fluids (i.e., hydraulic fluid) from equipment used to remove the tires from the pit. The VOCs 1,1,1-trichloroethane, 1,3-dichlorobenzene, chloromethane, and dichlorobenzene were detected in the surface sample from only one test pit location. The source of these compounds is unknown as they were detected at the surface from only one pit. VOCs were not detected in subsurface samples, indicating that there has not been any vertical migration. Based on the evaluation of the field investigation data according to USEPA guidance and procedures, chloromethane and diethyl phthalate were the COPCs identified at SWMU 13.

Ecological risk results for SWMU 13 are presented in the TEAD SWERA (Rust E&I 1996).

The results of the human health risk assessment do not indicate a concern to human health; therefore, it is recommended that no further remedial investigation need to be performed. A feasibility study will be conducted for SWMU 13, as required by CERCLA, to determine if any remedies are required for this site.

Conclusions from this report and the SWERA will be used during the FS process to derive final recommendations for SWMU 13.

5.4 BUILDING 1303 WASHOUT POND (SWMU 22)

5.4.1 Site Characteristics

The Building 1303 Washout Pond (SWMU 22) is located in the southwestern portion of TEAD-N (see Figure 1-2). SWMU 22 consists of a shallow depression that reportedly received washdown water from Building 1303. Building 1303 was a facility for sawing apart high-explosive bombs and projectiles. It was last used for an M-55 rocket assessment program and was closed in September 1984. The washdown water likely contained explosives as the water left the building. The washdown water ran from the building doors, across a concrete pad, into an unlined ditch, and to a shallow depression referred to as the Building 1303 Washout Pond. Most of the liquids from the washdown operation would have infiltrated into the ground before the depression filled. It is possible, however, that the depression may have filled and overflowed, resulting in the spreading of potentially contaminated water to surface soils.

5.4.2 Previous Investigations and Phase I and Phase II RI Activities

No previous environmental investigations had been conducted at SWMU 22 prior to the Phase I RI field activities. There are no operating records that define the composition of the washdown effluent or the duration of operations at Building 1303. Sampling and analysis for the Phase I RI consisted of 10 surface soil samples collected in the shallow drainage ditch (adjacent to the cement pad), small depression (pond), and spreading area downgradient of Building 1303. Locations of these samples are shown in Figure 5-11, and photographs of the sampling locations are provided in Appendix C. These samples were analyzed for explosives, metals, and anions.

Phase II RI field activities were performed by Rust E&I during the summer of 1994. During washdown operations, water within the ponding area likely provided a driving force for vertical transport. To assess this potential vertical migration, three soil borings were drilled to a depth of 10 feet in the shallow ditch that drains into the ponding area (Figure 5-12).

Samples were collected at depths of 0 to 6 inches, 4 to 5 feet, and 10 feet in each boring. One of the 10-foot borings was drilled between the concrete pad and the gravel bypass (BWB-94-01). The other 10-foot borings were both drilled in stained soil adjacent to the gravel bypass where the washdown water ran in a shallow drainage ditch prior to entering the ponding area (BWB-94-02 and -03). Drilling and sampling were difficult because a bed of calcium carbonate-cemented coarse gravels was encountered around 2 to 3 feet bgs. Sample recovery was also poor for the 5-foot and 10-foot samples. A total of 17 surface soil samples (plus an additional three surface soil samples from soil borings BWB-94-01A, BWB-94-02A, and BWB-94-03A) were also collected from locations in the potential spreading area, which surrounds the ponding area northeast of Building 1303 (Figure 5-12). These locations were selected on the basis of the topography of the area and on areas not covered by previous samples to further define the horizontal extent of contamination. During sampling of two of

the surface samples (BWS-94-01 and -03), located between the concrete pad and the gravel bypass, rusted nails and other metal debris were uncovered. Discolored soil was also found in surface sample number BWS-94-03. All of the Phase II soil samples collected were analyzed for explosives, metals, and cyanide.

5.4.3 Contamination Assessment

5.4.3.1 *Data Evaluation*

This section evaluates the analytical data for its usability in the risk assessment. A data evaluation was performed by reviewing the data quality codes assigned by the USAEC Chemistry Branch and EcoChem, an independent third-party validator. In an effort to ascertain the level of certainty/uncertainty, USEPA data qualification codes were then assigned as an aid in interpreting the data for use in the risk assessment. (Table 2-4 defines the relationship between the USAEC Chemistry Branch codes and USEPA data qualifiers.) The following sections summarize the results of this process.

5.4.3.1.1 ***Field Duplicates.*** The "D" flag code represents a field duplicate. All "D" flagged data were compared with the primary investigative result, and the higher of the two values was used.

5.4.3.1.2 ***Blank Assessment.*** The USEPA has determined that when blank contamination exists, the investigative results must exceed the blank result by a factor of 5 (all compounds) or 10 (common laboratory contaminatants such as acetone) in order to be considered positive. Several metals were detected in method and or rinsate blanks associated with SWMU 22 soil samples. Based on comparisons to blanks, the following positive results for metals were changed to nondetects. According to USEPA guidance (USEPA 1989), the associated blank concentration was considered to be the quantitation limit for the affected samples.

- Surface Soil
  -Aluminum—BWB-94-02A
  -Barium—BWB-94-02A and 03A
  -Iron—BWB-94-03A
  -Manganese—BWB-94-02A and -03A
  -Vanadium—BWB-94-01, -94-06, -94-09, -94-01A, -94-02A, and -94-03A

- Subsurface Soil
  -Aluminum—BWB-94-01B, -01C, -02B, -02C, -03B, and -3C
  -Barium—BWB-94-02B, -02C, -03B, and -03C
  -Iron—BWB-94-01B, -01C, -02B, -03B, and -03C
  -Manganese—BWB-94-01C, -02B, -02C, -03B, and -03C
  -Potassium—BWB-94-01C, -02B, -02C, -03B, and -03C
  -Vanadium—BWB-94-01B, -02B, and -03C

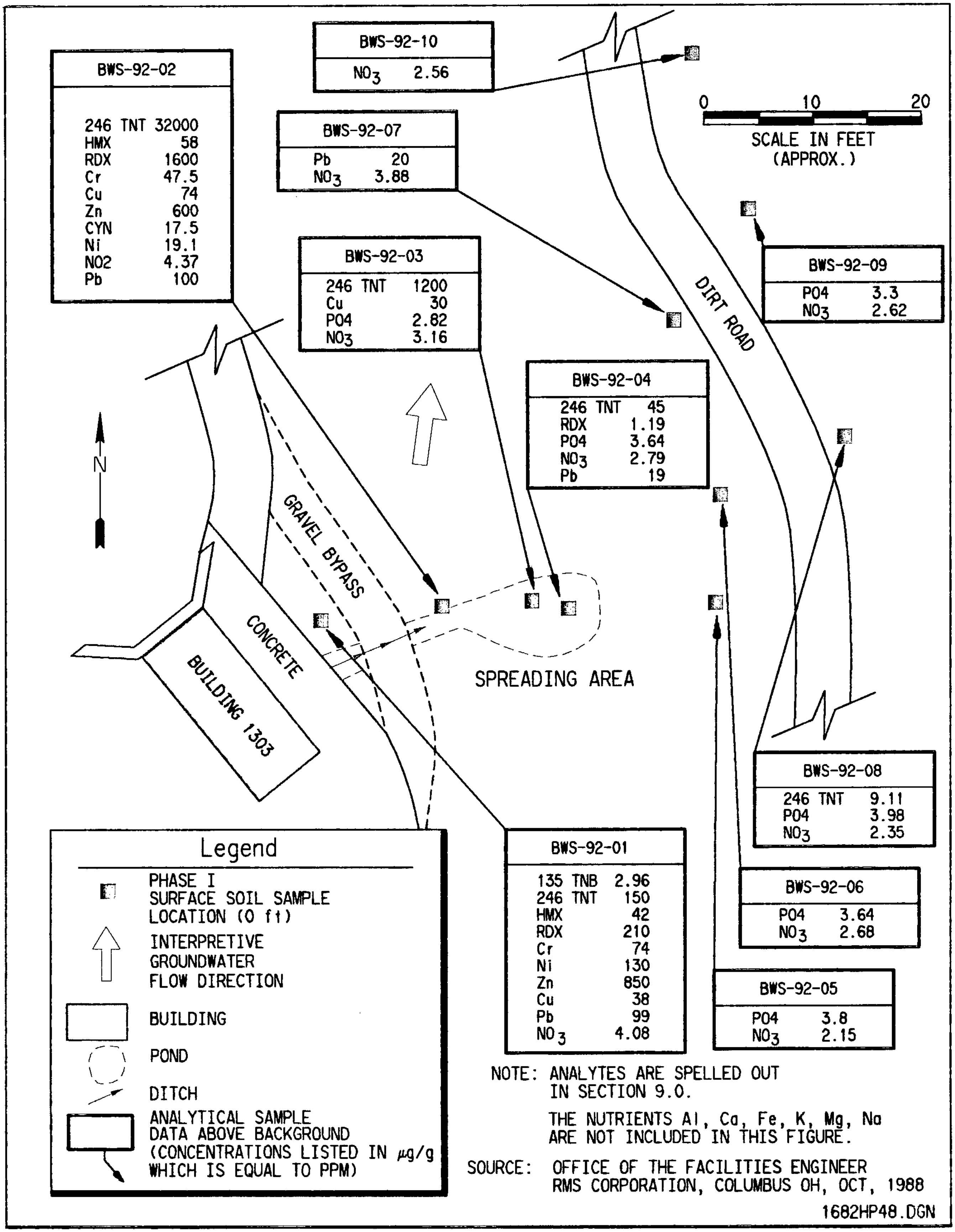

Figure 5-11. SWMU 22 Phase I Soil Sample Locations and Results

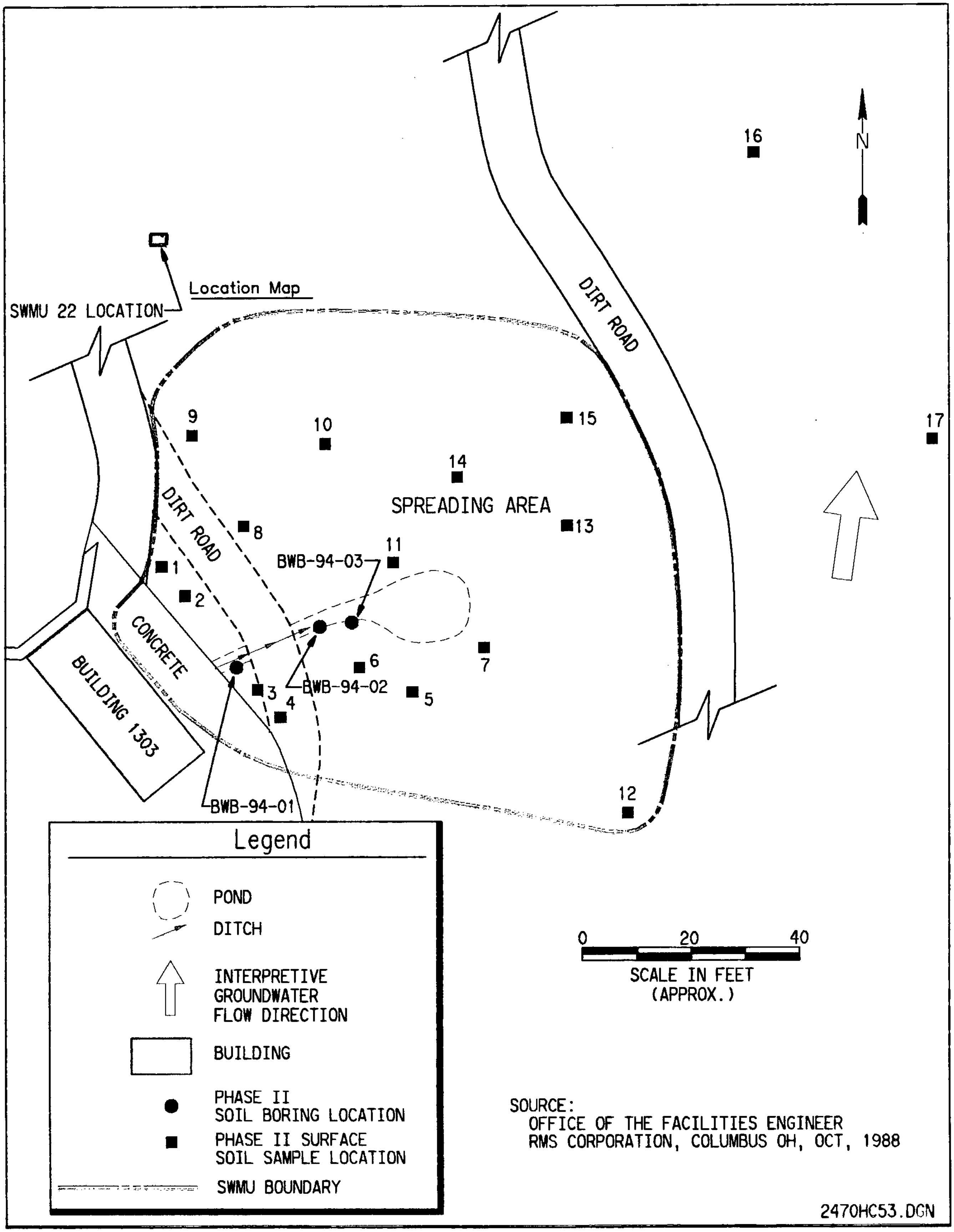

Figure 5-12. SWMU 22 Phase II Sample Locations

5.4.3.1.3 ***USAEC Chemistry Branch Validation.*** The USAEC Chemistry Branch reviewed the analytical data for technical deficiencies based on the *USATHAMA (USAEC) Quality Assurance Program (PAM 11-41)*. USAEC data qualifiers assigned by the Chemistry Branch would be an indication of QC recoveries outside of USAEC control limits and other technical deficiencies. Estimating the data for use in the risk assessment based on USAEC data qualifiers is judged to be a conservative approach since USAEC control limits are generally narrower than USEPA Functional Guidelines. For SWMU 22, all data were accepted for use without qualification.

Non-Certified Compounds. USAEC flag codes of R or T were assigned by the analytical laboratory to indicate non-detected compounds that had not been performance demonstrated or validated under the USAEC's 1990 QA program. Under this program, a distinction is made between "target" and "non-target" analytes. "Target" compounds are determined during the certification process, and CRLs for these analytes are established. "Non-target" compounds are those, which were added to the method to meet project-specific requirements. The lowest calibration standard typically reflects the PQL for that analyte. For the purpose of the risk assessment, the detection limit will be assigned a J-code, due to the uncertainty associated with not having undergone a rigorous certification process.

5.4.3.1.4 ***Independent Third-Party Data Validation.*** For 1994 data, a data quality assessment was completed using a validation effort by EcoChem, an independent third party. EcoChem's review and recommendations were based on USEPA Functional Guidelines as well as the *USATHAMA (USAEC) Quality Assurance Program (PAM 11-41)* and individual methods. All USEPA data qualifiers recommended by EcoChem were incorporated for use in the risk assessment and are provided in the analytical summary tables of Appendix J.

For SWMU 22, 1994 data, EcoChem reviewed one lot of cyanide analyses of soil samples by Method KY15 and one lot of ICP-metal analyses of soil samples by Method JS12.

For the cyanide analyses, Lot ANLG, EcoChem found all data acceptable for use without qualification.

For the ICP-metals analyses, Lot ANWJ, EcoChem rejected (R) all antimony detection limits due to 0 percent recovery in the MS/MSD, indicating the possibility of false non-detects. Vanadium results less than the high spike concentration (30 $\mu g/g$) were qualified (J) due to low spike recovery and should be considered biased low.

For SWMU 22, 1992 data, EcoChem evaluated one lot of explosive analyses of soil samples by Method LW26, and one lot of GFAA lead analyses of soil samples by Method JD13.

For the explosive analyses, Lot EGE, EcoChem assigned data qualifiers to two target compounds (2,4-dinitrotoluene and 2,6-dinitrotoluene) because of co-elution in one of the continuing calibration standards. They also estimated results for several other analytes (1,3,5-trinitrobenzene, 1,3-dinitrobenzene, 2,4-dinitrotoluene, 2,6-dinitrotoluene, 2-nitrotoluene, HMX, nitrobenzene, RDX and tetryl) due to holding time exceedences (see transfer sheet in

Appendix J for sample IDs). All other data included in this lot were found to be acceptable for use.

For the GFAA lead analyses, Lot FNZ, EcoChem found all data acceptable for use without qualification.

Listed below are the sample results rejected for use in the risk assessment.

- Surface Samples
  -Antimony—BWB-94-01A, -02A, -03A

- Subsurface Samples
  -Antimony—BWB-94-01B, -01C, -02B, 02-C, -03B, -03C

5.4.3.1.5 ***Data Evaluation Summary.*** A total of 30 surface soil samples (and 1 duplicate) and 6 subsurface samples were collected in 1992 and 1994 from 3 soil borings and 24 surface locations at SWMU 22. Samples from the borings were collected at 0, 4 to 5, and 10 feet. Samples were analyzed for one or more of the following groups of chemicals: anions, metals, explosives, and cyanide.

Because of blank contamination, positive results for a number of metals were changed to nondetects. However, the detected values in the affected samples were below background screening levels for the metals, indicating that this issue does not significantly impact the risk assessment results.

Antimony and thallium were not detected in any soil samples. The antimony and thallium reporting limits exceed the background screening values and the ingestion RBCs for these metals. Additionally, nine antimony nondetect results were rejected due to poor matrix spike recoveries. Therefore, the magnitude and extent of antimony and thallium contamination may not be adequately characterized at this SWMU.

Reporting limits for cadmium (1.2 μg/g) and silver (0.80 μg/g) were above their respective background screening values but less than their respective ingestion and soil-to-air RBCs. Therefore, this issue does not significantly impact the risk assessment results.

Over 99 percent of sample results were judged to be usable for risk assessment purposes. The number of samples and the analytical parameter list appear to be sufficient to characterize the nature, extent, and potential magnitude of contamination at this SWMU with exceptions noted above. A summary of chemicals detected in at least one surface or subsurface soil sample at SWMU 22 is presented in Appendix J, including data qualifiers (as appropriate) according to USEPA functional guidelines.

5.4.3.1.6 ***Background Screening.*** The maximum concentrations of inorganic chemicals detected in soil at SWMU 22 were compared to the site-specific background screening values

(see Section 2.6). Any inorganic chemical detected in at least one sample at a concentration higher than the background screening value was retained in the COPC database. Surface soil and subsurface soil were screened separately. The results of the background screening are shown in Table 5-110. Based on this screening analysis, cadmium, chromium, cobalt, copper, cyanide, iron, lead, nickel, silver, and zinc can be considered potential inorganic contaminants at SWMU 22. Only chromium, mercury, and vanadium are potential inorganic contaminants in subsurface soil.

The arsenic CRLs for the seven samples collected in 1992 were higher than the background screening value (CRLs ranged from 24 to 240 μg/g; the arsenic background screening value was 11.69). The detected concentrations of arsenic (samples collected in 1994) ranged from 3.02 to 5.54 μg/g.

The silver CRL for samples collected in 1994 (0.803 μg/g) was higher than the background screening value of 0.66 μg/g. Thallium was not detected in any soil sample, but the thallium CRL was higher than the background screening value of 11.70 μg/g.

5.4.3.2 *Summary of Analytical Results*

The list of analytes detected in surface and subsurface soil is provided in Table 5-111 for Phase I data and Table 5-112 for Phase II data. The complete data set is contained in Appendix H.

5.4.3.3 *Nature and Extent of Contamination*

The analytical results from the Phase I RI field activities revealed that the COPCs at SWMU 22 are the explosives 1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, HMX, and RDX; the metals chromium, iron, lead, nickel, copper, and zinc; and the anions nitrate, nitrite, phosphate, and cyanide. The explosives and metals contamination appears to extend from the edge of the concrete pad near Building 1303 to the shallow depression northeast of the building. An area of surface staining, indicating a high potential for contamination, was observed during the Phase I RI adjacent to the gravel bypass road, where the washdown water ran in a shallow ditch prior to entering the ponding area. The sample collected within this stained area (BWS-92-02) contained high levels of explosives and metals (Figure 5-11). This sample also contained cyanide at greater than three times background concentration of 5 μg/g. The two samples collected from the ponding area (BWS-92-03 and -04) contained explosives, but the only metal exceeding background were copper in sample BWS-92-03 and lead in sample BWS-92-04. An explosive contaminant was detected in only one of the remaining samples collected to the east and northeast of the ponding area (BWS-92-08). The vertical extent of explosives and metals contamination was not assessed for SWMU 22 during Phase I because no subsurface soil samples were collected. On the basis of Phase I results, it was determined that further investigation was needed in the area between Building 1303 and the ponding area to define the horizontal and vertical extent of contamination caused by the washdown water discharge from the building.

Table 5-110. Background Screening of Inorganic Chemicals Detected in Soil at SWMU 22

Chemical	Frequency of Detection[a]	Maximum Detected Value (μg/g)[b]	Site-specific Background Screening Value[c] (μg/g)	Exceeds Site-specific Background?
Surface Soil				
Aluminum	20/20	7,020	28,083	No
Arsenic	20/30	5.54	11.69	No
Barium	28/30	100	247	No
Cadmium	1/30	1.54	0.847	**YES**
Calcium	30/30	26,600	114,483	No
Chromium	30/30	74	20.62	**YES**
Cobalt	20/20	16.8	6.94	**YES**
Copper	30/30	74	24.72	**YES**
Cyanide	2/30	17.5	5	**YES**
Iron	29/30	65,000	22,731	**YES**
Lead	30/30	100	18.23	**YES**
Magnesium	20/20	3,580	7,062	No
Manganese	18/20	226	698	No
Nickel	20/30	130	17.40	**YES**
Potassium	20/20	2,930	5,450	No
Silver	10/30	2.63	0.66	**YES**
Sodium	20/20	174	337	No
Vanadium	15/20	10.7	28.39	No
Zinc	30/30	850	102.8	**YES**
Subsurface Soil				
Arsenic	4/6	4.7	11.69	No
Barium	2/6	66.4	247	No
Calcium	6/6	42,800	114,483	No
Chromium	6/6	56.9	20.62	**YES**
Cobalt	3/6	4.14	6.94	No
Copper	6/6	6.86	24.72	No
Iron	1/6	9,660	22,731	No
Lead	2/6	10.4	18.23	No
Magnesium	6/6	5,400	7,062	No
Manganese	1/6	184	698	No
Mercury	1/6	0.0754	0.0572	**YES**
Nickel	6/6	12.2	17.40	No
Potassium	1/6	1,280	5,450	No
Sodium	6/6	210	337	No
Vanadium	3/6	37.7	28.39	**YES**

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]Micrograms per gram.
[c]See Section 2.6.1.1 for an explanation of how the site-specific background screening values were calculated.

Table 5-111. Summary of Analytes Detected in Soil for the Bldg. 1303 Washout Pond (SWMU 22) - Phase I

Group	Analytes	Background Concentrations	BWS-92-01 (0ft)	BWS-92-02 (0ft)	BWS-92-03 (0ft)	BWS-92-04 (0ft)	BWS-92-05 (0ft)	BWS-92-06 (0ft)	BWS-92-07 (0ft)	BWS-92-08 (0ft)	BWS-92-09 (0ft)	BWS-92-10 (0ft)
METALS	BARIUM	247.1	88	100	39	48	58	82	55	58	67	70
	CHROMIUM	20.82	74*	47.5*	7.1	8.78	7.42	7.67	7.98	8.16	8.63	9.3
	LEAD	18.23	99*	100*	15	19*	10	9.2	20*	16	11	13
	SILVER	0.86	0.0848	0.18	0.119	0.234	0.0336	0.0335	0.0327	0.0291	0.0336	0.0259
	COPPER	24.72	38*	74*	30*	11.9	8.54	5.56	5.78	6.73	5.58	6.05
	IRON	22731	46000*	65000*	8000	8400	8900	9900	6600	10000	9900	11000
	NICKEL	17.4	130*	19.1*	LT 2.46	LT 2.46	LT 2.46	LT 2.46	LT 2.46	LT 2.46	LT 2.46	LT 2.46
	ZINC	102.8	850*	600*	47	76	28	28	36	35	31	39
ANIONS	NITRATE	N/A	4.08*	LT 3.36	3.16*	2.79*	2.15*	2.68*	3.88*	2.35*	2.62*	2.56*
	NITRITE	N/A	LT 3.16	4.37*	LT 3.16	LT 3.16	LT 3.16	LT 3.16	LT 3.16	LT 3.16	LT 3.16	LT 3.16
	PHOSPHATE	N/A	ND 5	ND 5	2.82*	3.64*	3.8*	3.64*	ND 5	3.98*	3.3*	ND 5
CYANIDE	CYANIDE	5	LT 5	17.5*	LT 5	LT 5	LT 5	LT 5	LT 5	LT 5	LT 5	LT 5
EXPLOSIVES	1,3,5-TRINITROBENZENE	N/A	2.96*	LT 3.5	LT 3.5	LT 0.352	LT 0.352	LT 0.352	LT 0.352	LT 0.352	LT 0.352	LT 0.352
	2,4,6-TRINITROTOLUENE	N/A	150*	32000*	1200*	45*	LT 0.931	LT 0.931	LT 0.931	9.11*	LT 0.931	LT 0.931
	HMX	N/A	42*	58*	LT 7.6	LT 0.766	LT 0.766	LT 0.766	LT 0.766	LT 0.766	LT 0.766	LT 0.766
	RDX	N/A	210*	1600*	LT 4.4	1.19*	LT 0.446	LT 0.446	LT 0.446	LT 0.446	LT 0.446	LT 0.446

Note.- All values in µg/g (equal to ppm).

N/A = Not Applicable.

* = Organic analyte detected above CRL or MDL or detected inorganic analyte exceeding background.

LT = Analyte concentration is less than CRL , the CRL is posted next to the "LT".

ND = Analyte not detected above the MDL, the MDL is posted next to the "ND".

Table 5-112. Summary of Analytes Detected in Soil for the Bldg. 1303 Washout Pond (SWMU 22) - Phase II

Surface Soil

Group	Analytes	Background Concentrations	BWB-94-01A (0.5ft)	BWB-94-02A (0.5ft)	BWB-94-03A (0.5ft)	BWS-94-01 (0.5ft)	BWS-94-02 (0.5ft)	BWS-94-03 (0.5ft)	BWS-94-04 (0.5ft)	BWS-94-05 (0.5ft)	BWS-94-06 (0.5ft)	BWS-94-07 (0.5ft)	BWS-94-08 (0.5ft)
CYANIDE	CYANIDE	5	LT 0.25	0.3	LT 0.25	LT 0.25	LT 0.25	LT 0.25	LT 0.25	LT 0.25	LT 0.25	LT 0.25	LT 0.25
EXPLOSIVES	1,3,5-TRINITROBENZENE	N/A	LT 0.922	2.96*	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922
	2,4,6-TRINITROTOLUENE	N/A	6.4*	1500*	7.05*	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2
	2,4-DINITROTOLUENE	N/A	LT 2.5	3.53*	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5
	HMX	N/A	22.2*	4.95*	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2
	RDX	N/A	40.6*	43.4*	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28
METALS	ALUMINUM	28083	7020	5940#	6440	4710	6380	5480	6020	5030	4730	5250	6560
	ARSENIC	11.69	4.61	4.58	3.55	4.88	4.47	4.24	3.69	3.02	3.27	3.5	3.7
	BARIUM	247.1	68.9	33.4#	48.7#	49.9	66	49.5	55.7	52	47.5	46.1	62.9
	CADMIUM	0.847	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2
	CALCIUM	114483	4610	5160	5360	20400	2700	18000	13600	5860	2990	3380	6800
	CHROMIUM	20.62	17.6	36.2*	13.9	10.1	6.96	8.37	8	6.34	5.82	5.95	7.22
	COBALT	6.94	16.8*	2.78	4.59	3.27	3.38	2.94	3.09	3.24	3.08	3.72	3.68
	COPPER	24.72	18.2	7.6	8.63	12.6	6.65	10.4	10.6	8.24	9.11	5.62	8.26
	IRON	22731	17900	8880	8360#	8740	9010	8040	8600	7610	7290	7690	9050
	LEAD	18.23	28.5*	43.1*	13.1	45.8*	10.1	31.5*	29.1*	15.2	19.3*	9.64	14.2
	MAGNESIUM	7061	2180	1410	1910	2840	2600	2980	3100	2630	2050	1970	2810
	MANGANESE	698.3	226	115#	136#	162	214	166	192	180	168	153	202
	NICKEL	17.4	10.3	6.93	5	3.68	4.26	3.24	3.19	3.04	2.79	LT 2.74	3.69
	POTASSIUM	5449	2930	1190	1410	1270	1660	2060	1610	1310	1300	1340	1740
	SILVER	0.66	LT 0.803	LT 0.803	LT 0.803	LT 0.803	LT 0.803	2.63*	LT 0.803	LT 0.803	LT 0.803	LT 0.803	LT 0.803
	SODIUM	337	167	97.1	96.6	164	132	138	148	174	156	111	152
	VANADIUM	28.39	11.1#	11.4#	10.6#	7.77#	9.16	9.23	9.35	8.49	7.78#	8.12	9.69
	ZINC	102.8	369*	92.8	45.6	67.4	27.1	50.8	60.9	25	22.8	21.4	32.4

Group	Analytes	Background Concentrations	BWS-94-09 (0.5ft)	BWS-94-09(D) (0.5ft)	BWS-94-10 (0.5ft)	BWS-94-11 (0.5ft)	BWS-94-12 (0.5ft)	BWS-94-13 (0.5ft)	BWS-94-14 (0.5ft)	BWS-94-15 (0.5ft)	BWS-94-16 (0.5ft)	BWS-94-17 (0.5ft)
CYANIDE	CYANIDE	5	LT 0.25	LT 0.25	LT 0.25	LT 0.25	LT 0.25	LT 0.25	LT 0.25	LT 0.25	LT 0.25	LT 0.25
EXPLOSIVES	1,3,5-TRINITROBENZENE	N/A	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922
	2,4,6-TRINITROTOLUENE	N/A	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2
	2,4-DINITROTOLUENE	N/A	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5
	HMX	N/A	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2
	RDX	N/A	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28
METALS	ALUMINUM	28083	6060	6060	6380	5530	6400	6170	5040	6410	5450	6320
	ARSENIC	11.69	3.78	4.18	3.31	3.25	4.28	3.46	3.97	3.7	4.51	5.54
	BARIUM	247.1	48.4	56.4	57.8	47.8	58.1	58.5	54.3	49.1	52.9	51.6
	CADMIUM	0.847	LT 1.2	LT 1.2	LT 1.2	1.54*	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2
	CALCIUM	114483	3030	3240	2220	2350	4970	22700	26600	11900	3750	2620
	CHROMIUM	20.62	5.44	8.77	7.75	7.51	8.82	14.8	7.03	7.02	7.34	7.49
	COBALT	6.94	3.02	3.28	4	3.77	3.29	3.4	3.12	2.78	3.68	3.11
	COPPER	24.72	9.48	8.95	7.29	8.05	11	16.5	8.1	9.81	10.2	7.82
	IRON	22731	7700	8340	9350	8850	10000	8940	6970	7310	7880	8480
	LEAD	18.23	18.7*	54.7*	8.94	12.5	36.1*	77.5*	16.9	22.3*	21.6*	13.3
	MAGNESIUM	7061	2100	2340	2350	2040	2720	3580	3410	2650	2330	2320
	MANGANESE	698.3	156	172	178	152	189	195	151	151	173	165
	NICKEL	17.4	LT 2.74	3.85	3.8	3.22	4.5	4.74	3.34	3.39	3.61	3.45
	POTASSIUM	5449	1280	1510	1700	1370	1460	1630	1410	1370	1440	1540
	SILVER	0.66	LT 0.803	LT 0.803	LT 0.803	LT 0.803	LT 0.803	LT 0.803	LT 0.803	LT 0.803	LT 0.803	LT 0.803
	SODIUM	337	105	109	150	113	140	153	133	140	140	109
	VANADIUM	28.39	7.37#	8.52	10.7	9.78	9.32	9.62	8.16	8.07	8.15	9.46
	ZINC	102.8	34.9	106*	25.9	29.3	94	76.1	31.9	29.9	49.1	32

Table 5-112. Summary of Analytes Detected in Soil for the Bldg. 1303 Washout Pond (SWMU 22) - Phase II (continued)

			Subsurface Soil					
Group	Analytes	Background Concentrations	BWB-94-01B (4ft)	BWB-94-01C (10ft)	BWB-94-02B (5ft)	BWB-94-02C (10ft)	BWB-94-03B (5ft)	BWB-94-03C (10ft)
EXPLOSIVES	2,4,6-TRINITROTOLUENE	N/A	4.47*	LT 2	65.7*	15*	2.09*	LT 2
	RDX	N/A	2.18*	LT 1.28	1.82*	LT 1.28	LT 1.28	LT 1.28
METALS	ARSENIC	11.69	4.7	LT 2.5	2.93	LT 2.5	3.96	3.79
	BARIUM	247.1	54.5	66.4	27.1#	36.3#	24.9#	10.8#
	CALCIUM	114483	42800	28000	27000	24100	14500	21000
	CHROMIUM	20.62	56.9*	26.2*	54.9*	24.6*	49.7*	31*
	COBALT	6.94	3.05	3.45	LT 2.5	4.14	LT 2.5	LT 2.5
	COPPER	24.72	4.81	4.89	3.3	6.86	4.83	4.54
	IRON	22731	7610#	4300#	3950#	9660	5100#	5310#
	LEAD	18.23	8.13	LT 7.44	LT 7.44	10.4	LT 7.44	LT 7.44
	MAGNESIUM	7061	5400	1470	1870	3200	1230	3090
	MANGANESE	698.3	184	42.8#	68.5#	72.6#	71.8#	55.9#
	MERCURY	0.0572	0.0754*	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	10.6	6.07	3.99	12.2	4.66	4.67
	POTASSIUM	5449	1280	495#	302#	459#	479#	298#
	SODIUM	337	178	210	104	194	110	95.4
	VANADIUM	28.39	15.8#	33.6*	7.62#	37.7*	21.1	8.31#

Note.- All values in μg/g (equal to ppm).

N/A = Not Applicable.

LT = Analyte concentration is less then CRL, the CRL is posted next to the "LT".

* = Organic analyte detected above CRL or MDL or detected inorganic analyte exceeding background.

\# = Analyte was detected in the associated blank in excess of the 5 or 10 times rule (as described in Section 3.1.1.1).

(D) = Duplicate analysis.

Phase II RI activities included the collection and analysis of 17 surface samples and the drilling and sampling of 3 soil borings to further define the horizontal and vertical extent of contamination caused by the wastewater discharged from Building 1303. No VOCs were detected with the HnU at this site. In addition, no Phase II RI surface or subsurface samples contained cyanide exceeding background concentrations. Several samples contained elevated levels of explosives and metals.

As determined from the results of the Phase I and Phase II RI sampling activities, the explosives contamination at SWMU 22 is limited to the shallow drainage ditch (adjacent to the cement pad and the gravel bypass) and the spreading area (Figures 5-11 and 5-13). Only one sample in the downgradient spreading area contained an explosive contaminant (Phase I sample BWS-92-08). During the Phase II investigation, explosives were detected only in the three soil borings that were drilled next to the concrete pad, in the drainage ditch, and in the washout pond (BWB-94-01, -02, -03, respectively). The following explosives were detected: 1,3,5-trinitrobenzene (2.96 $\mu g/g$), 2,4,6-trinitrotoluene (ranging from 2.09 to 1,500 $\mu g/g$), 2,4-dinitrotoluene (3.53 $\mu g/g$), HMX (ranging from 4.95 to 22.2 $\mu g/g$), and RDX (ranging from 1.82 to 43.4 $\mu g/g$). The highest concentrations of explosives were detected in sample BWB-94-02A located in the shallow drainage adjacent to the gravel bypass. This is the same location of stained surface soils where the highest explosive concentrations were detected during the Phase I RI (BWS-92-02). The vertical migration of explosives contamination also appears to be limited. Explosive contamination was not detected in the 10-foot samples collected from soil borings BWB-94-01 or -03. In soil boring BWB-94-02, however, 2,4,6-trinitrotoluene was detected at a concentration of 15 $\mu g/g$ at the 10-foot sample depth. The concentration of 2,4,6-trinitrotoluene decreased with depth from a concentration of 1,500 $\mu g/g$ in the surface sample (BWB-94-02A) to 15 $\mu g/g$ at 10 feet.

The Phase I RI surface sample results suggested that metals contamination was generally restricted to three surface-soil samples (BWS-92-01, -02, and -03) in the shallow drainage ditch. The Phase II data more fully characterized the horizontal and vertical extent of the metals contamination at Building 1303. In the Phase II RI samples, cadmium, chromium, cobalt, lead, mercury, silver, vanadium, and zinc were detected in above background concentrations. The contamination was mainly concentrated in the area of the shallow drainage ditch, but metals were also detected between the concrete pad and the gravel bypass and in the suspected spreading area. Rusted nails and other metal debris were encountered while collecting surface samples BWS-94-01 and BWS-94-03. BWS-94-01 samples contained elevated lead (at 45.8 $\mu g/g$) and BWS-94-03 contained elevated silver (2.63 $\mu g/g$) and lead (31.5 $\mu g/g$) concentrations. Concentrations of lead (54.7 $\mu g/g$-dup) and zinc (106 $\mu g/g$-dup) were detected above background concentrations in surface sample BWS-94-09 located adjacent to the gravel bypass and north of the drainage ditch. It is possible that the wastewater discharged from Building 1303 also contained metal debris, which were dispersed in the soils adjacent to the concrete pad and gravel bypass. This debris may have also been disposed of outside the building onto the soil. Lead was also detected (at 77.5 $\mu g/g$) in surface sample BWS-94-13; this sample was located between two of the Phase I sampling locations that contained elevated metals and/or explosives. This location also appeared to be located in a slight depression that extended downgradient to the northeast from the ponding area toward location BWS-92-08.

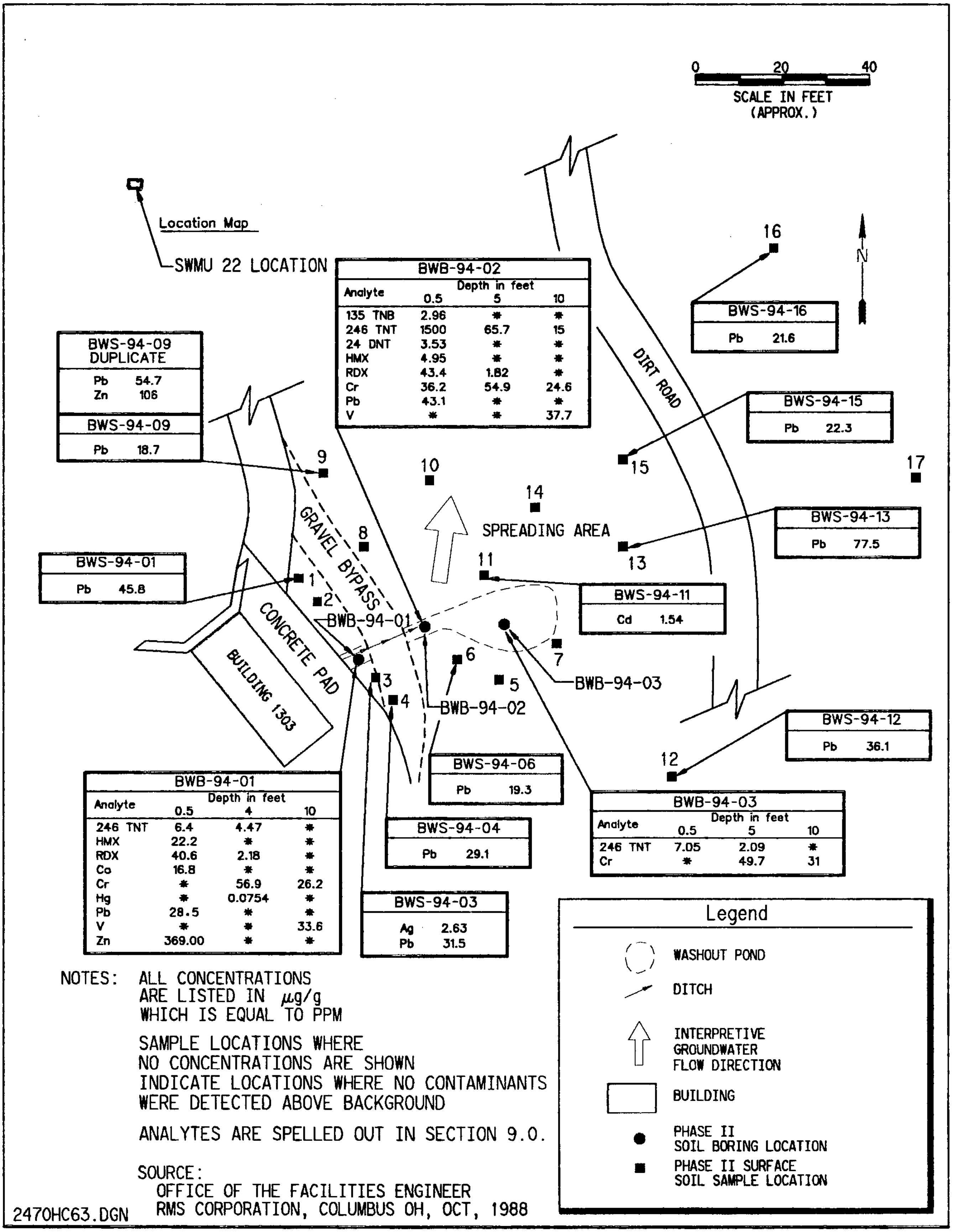

Figure 5-13. SWMU 22 Phase II Sample Locations and Results

This may have been a pathway for the wastewater to exit the ponding area during times when the pond overflowed. Lead in excess of background concentrations was also detected in surface soil samples BWS-94-04, BWS-94-06, BWS-94-12, BWS-94-15, and BWS-94-16, ranging from 19.3 to 36.1 $\mu g/g$. Cadmium was detected in BWS-94-11 at 1.54 $\mu g/g$.

Above background metals concentrations were detected in most of the soil samples collected from the soil borings drilled during Phase II. Cobalt (16.8 $\mu g/g$), lead (28.5 $\mu g/g$), and zinc (369 $\mu g/g$) were detected above background in the surface sample of soil boring BWB-94-01A. Calcium carbonate-cemented gravels were encountered in each soil boring starting at a depth of 2 to 3 feet. The 4-foot sample (BWB-94-01B) contained elevated levels of chromium (56.9 $\mu g/g$) and mercury (0.075 $\mu g/g$). Chromium (26.2 $\mu g/g$) and vanadium (33.6 $\mu g/g$) were detected above their respective background concentrations in the 10-foot sample (BWB-94-01C). In soil boring BWB-94-02, located adjacent to the gravel bypass, elevated chromium was detected in each of the samples collected at 0.5, 5, and 10 feet (36.2, 54.9, and 24.6 $\mu g/g$, respectively). In the same soil boring, lead was detected above background in the surface sample (at 43.1 $\mu g/g$), whereas elevated vanadium was detected in the 10-foot sample (at 37.7 $\mu g/g$). No metals were detected in the surface sample of soil boring BWB-94-03, but chromium was detected above the background concentration in both the 4-foot and 10-foot samples (at 49.7 $\mu g/g$ and 31 $\mu g/g$, respectively), with the concentration decreasing with depth.

The horizontal extent of the metals contamination, with the exception of lead, seems to be confined to the soils in the main wastewater pathway. The metals contamination was not present east of the dirt road except for slightly elevated lead levels (21.6 $\mu g/g$) at location BWS-94-16 (see Figure 5-13). The metals contamination is limited to an area northeast of Building 1303, including the shallow ditch, the ponding area, and three locations in the suspected overflow spreading area (BWS-94-13), where lead was found in concentrations at 77.5 $\mu g/g$. Various metals were detected at the surface but, below the contact of the caliche deposit, only chromium and vanadium were detected above background.

5.4.4 Human Health Risk Assessment

As part of the Phase II RI, an RA was conducted to estimate potential human health risks associated with the no-action alternative for SWMU 22, Building 1303 Washout Pond. The following tasks were completed in the RA:

- Data analysis and selection of COPCs
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Conclusions and recommendations

This section provides a summary of the quantitative process employed at SWMU 22 and the results of that process. The RA for SWMU 22 is based on the methodology described in Section 3.1 and supported by Appendices L, M, N, and O.

5.4.4.1 *Selection of the Chemicals of Potential Concern—Soil*

As detailed in Region VIII guidance, a screening procedure can be used to narrow the list of contaminants at a particular site to a subset of analytes that can be considered the COPCs for the area. This screening procedure can involve up to four steps, depending on the contaminants present:

- Group data by chemical class (e.g., carcinogenic PAHs)
- Evaluate frequency of detection
- Evaluate essential nutrients
- Compare site data to risk-based screening concentrations (Region III values)

Below is the screening analysis for SWMU 22.

5.4.4.1.1 ***Data Grouping.*** No data grouping was necessary as part of COPC selection at SWMU 22.

5.4.4.1.2 ***Frequency of Detection.*** Two analytes, 2,4-dinitrotoluene and cadmium, were detected in fewer than 5 percent of surface soil samples. However, since the CRL for cadmium was higher than background for many of the samples, cadmium was retained in the database. The explosive 2,4-dinitrotoluene was also retained because, based on the history of the SWMU, this compound would be expected to be present in surface soils. Evaluation of frequency of detection was not undertaken on subsurface soil samples because of too few samples.

5.4.4.1.3 ***Nutrient Screening.*** Iron was the only nutrient detected above background in surface soil. Since the maximum value (65,000 μg/g) was less than the nutrient screening value (70,000 μg/g), iron was eliminated as a COPC in surface soil. No nutrient chemicals were detected in subsurface soil above background screening values.

5.4.4.1.4 ***Region III RBC Screening.*** The final step in the COPC selection process consisted of comparing the EPCs for remaining contaminants in surface and subsurface soil with Region III RBCs. However, before these comparisons were made, a "hot spot" analysis was conducted.

Hot Spot Analysis. Most of the contamination at this SWMU was limited to surface soil in an area defined by sample locations BWS-92-01, -02, and -03, and BWB-94-01, -02 and -03 (see Figure 5-13). However, as shown in Figure 5-12, SWMU 22 is smaller than a residential lot. Therefore, all samples collected within the boundary of the SWMU were combined to determine the EPCs for surface and subsurface soil. The five surface soil samples collected from outside of the SWMU boundary to the northeast (BWS-92-08, -09, -10 and BWS-94-16 and -17) were combined for a separate analysis.

Table 5-113 provides a summary of the EPCs for preliminary COPCs in surface and subsurface soil at SWMU 22.

Soil-related Exposure Pathways. To select COPCs for the soil-related exposure pathways, the EPCs for the site in surface and subsurface soil were compared to Region III soil ingestion and soil-to-air RBCs. As shown in Table 5-114, only three surface soil analytes were retained as COPCs for these pathways within the boundary of SWMU 22: 1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, and RDX. Only 2,4,6-trinitrotoluene and chromium were retained as COPCs in subsurface soil. No chemicals were retained as COPCs in the surface soil outside of the SWMU boundary.

5.4.4.1.5 *Site-wide Soils.* Concentrations of the COPCs for surface soils—1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, and RDX—were calculated on a site-wide basis for the purpose of evaluating site-wide exposure scenarios. Site-wide concentrations were calculated utilizing all surface soil samples collected at SWMU 22. The site-wide concentrations of these surface soil COPCs are provided in Table 5-115.

5.4.4.2 *Selection of Chemicals of Potential Concern-Air*

For all receptors with the exception of the construction worker, the air pathway (i.e., inhalation of particulates) is evaluated on a SWMU-wide basis rather than by area of concern. Because all COPCs in soils were either metals or semi-volatile organics with very low volatility, potential exposures to wind-blown particulate would be contributed to by the entire SWMU (as well as exposed soil outside the defined SWMU), regardless of the specific SWMU-related activity. This was also assumed for potential off-site receptors. Air emissions of SWMU-related chemicals were assumed to occur by entrainment from wind erosion of particulate-bound COPCs. With entrainment, it is assumed that small amounts of the organic compounds or heavy metals become airborne and adsorbed onto the surface of dust particles.

A volatilization emission analysis was performed (SEC Donahue 1992b) using a volatilization release estimation equation designed for chemicals spilled or incorporated into soils (USEPA 1988a). Results from this analysis indicated negligible air quality impacts derived from volatilization releases from SWMUs located at TEAD. In addition, results from previous modeling conducted for adjacent sites with similar VOC concentrations revealed insignificant releases (SEC Donahue 1992b).

For current and future on-site receptors, COPCs retained for the soil pathways were used to evaluate exposures from air. For current off-site receptors, exposure point concentrations generated for COPCs retained for the on-site soil pathways were modeled using SCREEN2 to estimate the air quality impacts at selected sites surrounding TEAD. To maintain a health-protective approach, the RME EPC for children was used as the input soil concentration to the model. Off-site air concentrations generated by the model were screened against USEPA Region III Risk-Based Concentrations guidance (Table 5-116) to verify the negligible

Table 5-113. Summary of Preliminary Chemicals of Potential Concern (SWMU 22)

Chemical	Frequency of Detection[a]	Range of Detected Values (μg/g)[b]	Range of Reporting Limits (μg/g)	Arithmetic Mean Concentration (μg/g)	95% UCL[c] Concentration (μg/g)	Exposure Point Concentration[d] (μg/g)
Inside SWMU Boundary - Surface Soil						
Cyanide	2/25	0.30 - 17.5	0.25 - 5.00	0.953	2.99	2.99
Nitrate	6/7	2.15 - 4.08	3.36	2.92	3.95	3.95
Nitrite	1/7	4.37	3.16	1.94	2.82	2.82
1,3,5-Trinitrobenzene	2/25	2.96	0.35 - 3.50	0.672	0.968	0.968
2,4-Dinitrotoluene	1/25	3.53	0.74 - 74.0	1.85	3.06	3.06
2,4,6-Trinitrotoluene	7/25	6.40 - 32,000	0.93 - 2.00	167	9,992	9,992
RDX	5/25	1.19 - 1,600	0.45 - 4.40	13.0	127.8	127.8
HMX	4/25	4.95 - 58.0	0.76 - 7.60	3.50	8.70	8.70
Cadmium	1/25	1.54	0.42 - 4.20	0.670	0.892	0.892
Chromium	25/25	5.34 - 74.0	NA[e]	12.6	17.2	17.2
Cobalt	18/18	2.78 - 16.8	NA	3.95	4.79	4.79
Copper	25/25	5.55 - 74.0	NA	12.9	17.2	17.2
Lead	25/25	8.94 - 100.0	NA	29.5	42.2	42.2
Nickel	19/25	2.79 - 130	2.46 - 2.74	6.03	10.6	10.6
Silver	8/25	0.033 - 2.63	0.80	0.430	0.728	0.728
Zinc	25/25	21.4 - 850	NA	91.5	156.0	156.0
Inside SWMU Boundary - Subsurface Soil						
2,4,6-Trinitrotoluene	4/6	2.09 - 65.7	2.00	12.5	2,425	65.7
RDX	2/6	1.82 - 2.18	1.28	1.07	2.38	2.18
Chromium	6/6	24.6 - 56.9	NA	40.5	62.3	56.9
Mercury	1/6	0.075	0.05	0.033	0.057	0.057
Vanadium	3/6	21.1 - 37.7	3.74	16.4	30.1	30.1
Outside SWMU Boundary - Surface Soil						
2,4,6-Trinitrotoluene	1/5	9.11	0.93 - 2.0	1.97	94.0	9.11
Lead	5/5	11.0 - 21.6	NA	15.0	20.5	20.5

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]Micrograms per gram.
[c]Upper confidence limit.
[d]The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
[e]Not applicable.

Table 5-114. Selection of Chemicals of Potential Concern Based on EPA Region III's RBCs (SWMU 22)

	EPA[a] Region III RBC[b] Screen			
	Residential RBCs (μg/g)[c]			
Chemical	Ingestion	Inhalation	Exposure Point Conc. (μg/g)	Retained as COPC[d]
Surface Soil - Inside SWMU Boundary				
Cyanide	160	NA[e]	2.99	No
Nitrate	13,000	NA	3.95	No
Nitrite	780	NA	2.82	No
1,3,5-Trinitrobenzene	0.39	NA	0.968	**YES**
2,4-Dinitrotoluene	16.0	12.0	3.06	No
2,4,6-Trinitrotoluene	21.0	NA	9,992	**YES**
HMX	390[f]	NA	8.70	No
RDX	5.8[f]	NA	127.8	**YES**
Cadmium	3.9	920	0.892	No
Chromium	39.0	140	17.2	No
Cobalt	470	NA	4.79	No
Copper	310	NA	17.2	No
Lead	400[g]	NA	42.2	No
Nickel	160	6,900	10.6	No
Silver	39.0	NA	0.728	No
Zinc	2,300	NA	156.0	No
Subsurface Soil - Inside SWMU Boundary				
2,4,6-Trinitrotoluene	21.0	NA	65.7	**YES**
RDX	5.8[f]	NA	2.18	No
Chromium	39.0	140	56.9	**YES**
Mercury	2.3	0.70	0.057	No
Vanadium	55.0	NA	30.1	No
Surface Soil - Outside SWMU Boundary				
2,4,6-Trinitrotoluene	21.0	NA	9.11	No
Lead	400[g]	NA	20.5	No

[a]U.S. Environmental Protection Agency.
[b]Risk-based concentrations. RBCs were taken directly from the Region III RBC Table (USEPA 1995), except as noted in the footnotes. Values for noncarcinogens are 1/10 of the Region III RBC.
[c]Micrograms per gram.
[d]Chemicals of potential concern.
[e] Not applicable.
[f]Calculated according to Region III guidance (USEPA 1995).
[g]OSWER recommended clean-up level for lead in residential soil (USEPA 1994).

Table 5-115. Site-Wide Surface Soil Exposure Point Concentrations of Chemicals of Potential Concern (SWMU 22)

Chemical	Frequency of Detection[a]	Range of Detected Values (µg/g)	Range of Reporting Limits (µg/g)	Arithmetic Mean Concentration (µg/g)	95% UCL Concentration (µg/g)	Exposure Point Concentration[b] (µg/g)
1,3,5-Trinitrobenzene	2/30	2.96	0.922 - 3.5	0.602	0.84	0.84
2,4,6-Trinitrotoluene	8/30	6.40 - 32,000	0.93 - 2.0	96.0	2,157	2,157
RDX	5/30	1.19 - 1,600	0.45 - 4.40	8.56	49.4	49.4

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (USEPA 1989).
[c]Not applicable.

Table 5-116. Selection of Chemicals of Potential Concern for Off-site Air-related Pathways Based on EPA Region III's Risk-Based Concentration Screening Guidance (SWMU 22)

Chemical	RME SWMU-wide Soil Exposure Point Conc. (mg/kg)[c]	EPA Region III Risk-Based Concentration[a] Screen (µg/m³)[b]					
		Exposure Point Conc. at Property Line	Exposure Point Conc. at Grantsville	Exposure Point Conc. at Tooele	Exposure Point Conc. at Stockton	Ambient Air RBC	Retained as off-site COPC[d]?
RDX	49.4	0.00000091	0.000000045	0.000000033	0.000000046	0.057	No
1,3,5-Trinitrobenzene	0.84	0.0023	0.00011	0.000085	0.00012	0.018	No
2,4,6-Trinitrotoluene	2,157	0.000053	0.0000026	0.0000019	0.0000027	0.21	No

[a]Values for noncarcinogens are 1/10th of the Region III RBC (USEPA 1996).
[b]Micrograms per cubic meter.
[c]Milligrams per kilogram.
[d]Chemicals of potential concern.

contribution of this pathway. SCREEN2 is a single-source, screening-level model that has algorithms to estimate air quality impacts associated with air sources. For a complete description of the SCREEN2 model and associated results, see Appendix N. As shown in Table 5-116, based on comparison to air RBC, no COPCs were retained for quantitative off-site evaluation.

5.4.4.3 *Selection of the Chemicals of Potential Concern—Groundwater*

The selection of COPCs for the groundwater exposure pathways consist of a two-phase modeling approach. Initially, the *maximum* concentration of each analyte detected in either surface or subsurface soil was compared to the Region III soil-to-groundwater RBC. One-tenth of the value was used for noncarcinogens. If the maximum concentration of a chemical exceeded the soil-to-groundwater RBC, the chemical was selected for vadose zone modeling (Table 5-117). The modeled break-through concentration in groundwater for these chemicals was then compared to the Region III tap water RBCs, with one-tenth of the value used for noncarcinogens. In addition, the modeled break-through time was compared to the 100-year cut-off period as described in Section 2.7.2. A chemical that reached the water table within 100 years *and* had a modeled break-through concentration that exceeded the Region III tap water RBC (one-tenth of the value for noncarcinogens) was retained for further vadose-saturated zone modeling to on- and off-site hypothetical receptors as described in Section 2.7.2. For this second phase of modeling, the *average* surface and subsurface soil concentration was used to calculate the initial pore water concentration at the site. Again, the vadose-saturated zone modeling results were compared to the Region III tap water RBCs, with one-tenth for noncarcinogens. If the chemical still failed to meet the 100-year break-through criteria *and* exceeded the Region III tap water RBC, it was retained for quantitative risk assessment. As shown in Table 5-113, 1,3,5-trinitrobenzene, 2,4-dinitrotoluene, RDX, HMX, cadmium, chromium, copper, lead, nickel, vanadium, nitrate, nitrite, and cyanide were retained for vadose zone modeling.

5.4.4.3.1 ***Vadose Zone Model Results.*** The soil screening described in the previous sections indicated that 13 COPCs should be evaluated using the soil-vadose-zone-groundwater-screening model at SWMU 22. These COPCs consist of the six metals; four explosive compounds; and cyanide, nitrate, and nitrite as indicated in Table 5-117. The vadose-zone modeling set-up procedures are described in detail in Section 2.7.2 of this report. This section defines the site-specific parameters and presents the vadose-zone modeling results.

The SWMU 22 site-specific input parameters are defined as the thickness of the vadose zone (H cm), the area of contamination (CA m^2), and the thickness of the contaminated zone (H cont, cm). These input parameters, along with the COPC chemical-specific parameters are used as the input for the GWM-1 and MULTIMED models. The above site-specific

Table 5-117. Selection of COPCs for Groundwater Exposure Pathways (SMWU 22)

Chemical	Maximum Above Background (μg/g)[a]	Depth	Soil-to-GW[b] RBC[c] (μg/g)	Selected for Vadose Zone Modeling?	Reached Water Table Within 100 Years	Model Output: Break-Through Point Concentration in Groundwater (mg/L)[d]	Tap Water RBC (mg/L)	Selected as COPC[e] for Groundwater?
Cyanide	17.5	Surface	0.04	YES	No	---	---	No
Nitrate	4.08	Surface	2	YES	No	---	---	No
Nitrite	4.37	Surface	0.2	YES	No	---	---	No
1,3,5-Trinitrobenzene	2.96	Surface	0.00073[f]	YES	No	---	---	No
2,4-Dinitrotoluene	3.53	Surface	0.02	YES	No	---	---	No
2,4,6-Trinitrotoluene	32,000	Surface	0.053[f]	YES	No	---	---	No
HMX	58.0	Surface	0.06	YES	YES	2.69	0.03	YES
RDX	1,600	Surface	0.002	YES	YES	74.0	.00006[f]	YES
Cadmium	1.54	Surface	0.6	YES	No	---	---	No
Chromium	74.0	Surface	1.9	YES	No	---	---	No
Cobalt	16.8	Surface	119[f]	No	No	---	---	No
Copper	74.0	Surface	31[f]	YES	No	---	---	No
Lead	100.0	Surface	15	YES	No	---	---	No
Mercury	0.075	Subsurface	0.3[f]	No	No	---	---	No
Nickel	130	Surface	2.1	YES	No	---	---	No
Silver	2.63	Surface	19[f]	No	No	---	---	No
Vanadium	37.7	Subsurface	5.2[f]	YES	No	---	---	No
Zinc	850	Surface	4,200	No	No	---	---	No

[a]Micrograms per gram.
[b]Groundwater.
[c]Risk-based concentrations. RBCs were taken directly from the Region III RBC Table except as indicated in the footnotes.
[d]Milligrams per liter.
[e]Chemicals of potential concern.
[f]Calculated according to Region III guidance (USEPA 1995).

parameters for SWMU 22 are as follows:

H	=	12,000 cm
CA	=	115 m^2
H cont	=	305 cm

Other key COPC-specific parameters—the distribution coefficient (Kd), the maximum observed soil concentration (Tc), the initial pore water concentration (C_{init}), and the plume pulse duration (p.d.)—are shown in Table 5-118. All of the GWM-1 spreadsheets associated with the SWMU-specific COPCs are in Appendix K along with the MULTIMED output concentrations. Table 5-118 summarizes these COPC-specific parameters and shows the MULTIMED output for COPC break-through time (time after leaching starts, that the leading edge of the COPC plume reaches the top of the water table) along with the COPC estimated concentration at the time that breakthrough occurs. One key to interpreting these estimates is that the pore water concentration was determined by starting with the maximum observed soil concentration measured at the site (see Table 5-118) and calculating the maximum concentration available for the pore water solution by soil-water partitioning. As explained in Section 2.7, the equation used is very dependent on Kd and does not take into account mineral solubility and equilibrium relationships. This is evident by some of the high C_{init} (initial pore water) concentrations estimated for several of the COPCs.

5.4.4.3.2 ***Groundwater COPCs.*** As shown in Table 5-118, the MULTIMED output indicates that within a 100-year time period only RDX and HMX will travel downward through the vadose zone and reach the water table. No other COPCs reach the water table within this period. As discussed in detail in Section 2.7.2., the conservative approach was the bases for the model calculations.

Table 5-118 illustrates this concept, showing the critical input and output parameters and the estimated break-through time for each COPC. This table also shows the estimated concentration associated with the arrival of the leading edge of the COPC plume at the water table. Again, it should be noted that the break-through time calculation does not take into account the various retardation influences, such as biodegradation, volatilization, absorption, adsorption, and mineral-solution equilibrium. In addition, the COPC concentration of break-through is based on the maximum observed soil concentration.

It is estimated that RDX and HMX will reach the water table in 93 years at a concentration of 74 mg/L, and 2.69 mg/L, respectively, based on the conservative assumptions of the model. The remainder of the COPCs ranged in break-through time from 113 years for 2,4-dinitrotoluene to over 91,000 years for nickel and vanadium. The results show that only the future land use scenarios required assessment of the risks associated with the groundwater exposure pathway.

Table 5-118. Summary of Critical I/O GWM-1 and MULTIMED Parameters for SWMU 22

COPC[(a)] Specific Parameters						
Analyte	Kd[(b)]	Tc[(c)] (max) (ppm)[(d)]	C_{leak}[(e)] (mg/L)[(f)]	Breakthrough Time (yrs)	Breakthrough Conc. (mg/L)	p.d.[(g)] (yrs)
Cadmium	1.3	1.54	1.12	1250	0.011	74
Chromium	1.2	74	62.8	1150	0.52	69
Copper	1.4	74	54.5	1350	0.59	79
Lead	4.5	100	24.1	3800	0.198	242
Nickel	150	130	0.96	>91000	ND[(h)]	7883
Vanadium	1000	37.7	0.0419	>91000	ND	52520
1,3,5-Trinitrobenzene	1	2.96	2.96	133	0.047	58
2,4-Dinitrotoluene	1	3.53	3.53	113	0.065	58
2,4,6-Trinitrotoluene	1	32000	32000	563	335.6	58
RDX	1	1600	1600	93	74	58
HMX	1	58	58	93	2.69	58
Nitrate	1	4.08	4.08	953	0.021	58
Nitrite	1	4.37	4.37	953	0.023	58
Cyanide	1	17.5	17.5	953	0.091	58

Note.—Site-specific parameters are as follows: vadose zone thichness (H) = 12,000 cm; area of contaminated soil (CA) = 115 m^2; thickness of contaminated soil (Hcont) = 305 cm.

[a]Chemicals of potential concern.
[b]Distribution coefficient and is dimensionless.
[c]Maximum observed soil concentration (ppm).
[d]Parts per million.
[e]Pore water concentration at the source as conservatively calculated by GWM-1.
[f]Milligrams per liter.
[g]Pulse duration as calculated by GWM-1.
[h]Not determined.

To further evaluate the potential for RDX and HMX to affect human health, the saturated zone module MULTIMED was expanded to estimate the maximum on-site COPC concentration and the maximum off-site concentration at a hypothetical receptor on the northern boundary of TEAD-N (see Figure 2-4). Various input parameters were adjusted to accommodate the saturated zone modeling to the on-site and off-site receptors. These parameters included the aquifer thickness (50 meters), the mixing zone thickness (50 meters), and the initial pore water concentration (set equal to the *average* observed soil concentration). In addition, the hydraulic gradient (0.0058—dimensionless) and distance (8,200 meters) to the off-site receptor were adjusted to represent simulation to the hypothetical receptors at SWMU 22 (see Section 2.7.2). The remaining input parameters were not adjusted. The hydraulic gradient, distance to the off-site receptor, and the modeling results are presented in Table 5-119. These results are further discussed in the risk assessment sections. The on-site receptor was set to 1 meter from the point that the COPC first reached the water table, thus representing the saturated zone directly underlying the SWMU. Based on the results shown in Table 5-119, both chemicals were carried through as groundwater COPCs for future on-site adult residents.

5.4.4.4 *Exposure Assessment*

Exposure is defined as the contact of a receptor with a chemical (USEPA 1989c). Exposure assessment is the estimation of the magnitude, frequency, and duration for each identified route of exposure. The magnitude of an exposure is determined by estimating the amount of chemical available at the receptor exchange boundaries (i.e., lungs, gastrointestinal tract, or skin) during a specified time period.

Section 3.1.2 describes the general tasks comprising the exposure assessment. The specific application of these tasks to SWMU 22 is described below.

5.4.4.4.1 ***Characterization of Exposure Setting***. The first step in developing exposure scenarios for SWMU 22 was to characterize the site setting in which potential exposures might occur. The characteristics of the site setting influence the types of transport mechanisms and the type of receptor exposure that could occur. The site setting also provides a basis for identifying the potential receptors (either real or, in the case of site redevelopment for alternative use, hypothetical). Both current land use patterns and future land use patterns were examined as part of the characterization.

Current Land Use. As is true for other areas of TEAD-N, public access to SWMU 22 is controlled, thereby precluding transient exposure. SWMU 22 is located in the south-central portion of TEAD-N and will remain part of the depot mission for the foreseeable future. Building 1303 has been identified as having the potential for future activity that could possibly require on-site workers to spend 10 hours per day, 4 days per week there.

Based on the above information, potential receptors under current land use were defined as SWMU-specific laborers and security personnel. These are individuals with job descriptions

Table 5-119. Summary of Vadose Zone and Saturated Zone Modeling for SWMU 22 (Using Average Soil Concentrations)

SWMU	Chemical	Tc[a] (avg) ppm[b]	C_{init}[c] (mg/L)[d]	Est. Peak On Site Conc. (mg/L)	Est. Peak On Site Time (yrs)	Est. Peak Off Site Conc. (mg/L)	Est. Peak Off Site Time (yrs.)	Est. Hydraulic Gradient	Est. Contaminated Area (m^2)	Est. Distance to Receptor (m)
22	RDX	53.2	53.2	0.4247	143	0.0000052	653	0.0058	115	8,200
22	HMX	4.38	4.38	0.03497	143	0.00000011	1,600	0.0058	115	8,200

[a] Maximum observed soil concentration (ppm).
[b] Parts per million.
[c] Pore water concentration of the source as conservatively calculated by GWM-1.
[d] Milligram per liter.

that call for repeated, moderate to heavy labor in the general vicinity of SWMU 22 and staff assigned to maintenance of the perimeter or security personnel that repeatedly work in the vicinity of SWMU 22.

It was assumed that the SWMU-specific laborer scenario would provide a sufficient upper bound on risk. Because other potential receptors would be exposed only intermittently to SWMU 22, SWMU-specific laborers and security personnel were the only receptors evaluated quantitatively as a current-use scenario. This approach provides a series of upper-bound estimates.

Cattle grazing is permitted at TEAD-N, with grazing allotments competitively bid and leased every 5 years to a single rancher. The current lease is up for rebid in 1996. Grazing at TEAD-N typically occurs between October 15 and May 31, with calving taking place in January. The calves remain at the facility until May 31 when they are either moved to feedlots or to other grazing areas. The calves typically do not return to TEAD-N after their initial exposure, and they are eventually sold as slaughter cattle for human consumption. Distribution is through regional and national distribution networks. The cows are normally utilized as breeding stock and may or may not return to the site during consecutive years. The current lessee brings approximately 1,000 head, mostly heifers, to winter pasture at TEAD-N and maintains summer pasture in Idaho (M. Walker, personal communication with Rust E&I, 1994).

SWMU 22 is one of several SWMUs on one grazing allotment currently under lease. Consumption of beef grazed on the allotment of which SWMU 22 is a part is evaluated in a separate section (Section 5.7) of the risk assessment.

Future Land Use. It was assumed that no change in current use other than the aforementioned is planned for the SWMU 22 vicinity. Current BRAC recommendations retain SWMU 22's function as part of the depot's mission. However, should the mission of TEAD-N change in the future, two additional exposure scenarios unique to planned or potential future use of SWMU 22 were developed.

- Skilled laborers – Individuals assigned to short-term construction in the vicinity of SWMU 22 during potential redevelopment.
- Inhabitants of an on-site residence(s) – Individuals who live in residences established at the time that depot property should ever be transferred for redevelopment.

5.4.4.4.2 ***Characterization of Potential Exposure Pathways***. An exposure pathway is the route COPCs take to reach potential receptors. Section 3.1.2.1 and 3.1.2.2 describe the methodology for characterization of exposure pathways. This methodology was then applied to SWMU 22. The following sections describe the potential exposure pathways associated with SWMU 22 for the current and future land use scenarios.

Current Land Use. Currently, the majority of laborers at TEAD-N work 10-hour days with 4-day weeks. A total of 4 weeks off a year for vacation, holidays, and sick leave yields 192 days per year on the job. It is assumed that a laborer could be at any specific SWMU from 2 (CTE) to 10 (RME) hours per day and will incidentally ingest, inhale, or become in contact with surface soil through worker-related activities. Military personnel are rotated on assignment an average of every 3 years (S. Culley, personal communication with Rust E&I, 1994). If a laborer is a civilian, the length of assignment could be expected to range as high as 25 years. It is assumed that all of the exposure is from outdoor tasks or activities. Specific parameters relating to ingestion, contact, and ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

Future Land Use. No change in current use is planned for the Building 1303 Washout Pond. Current BRAC recommendations retain SWMU 22's function as part of the depot's mission. However, should the mission of TEAD-N change in the future, land associated with SWMU 22 may be used at some future time for residential development. Based on this assumption, the future on-site adult and child resident are evaluated for the future land use scenario.

For the future on-site adult resident, it was assumed that at least one parent would spend much of his or her time away from home in activities such as working at another location, household errands, personal care (e.g., medical/dental appointments), or leisure activities. Based on this assumption, the total estimated time an adult will spend at home is approximately 15 to 19 hours per day, during which time he or she may incidentally ingest, inhale, or come in contact with surface soil while conducting activities such as gardening, mowing, or outdoor sports. It is also expected that the future on-site resident will grow and harvest vegetables and fruits from a home garden. For children and adolescents ages 0 to 18, time activity patterns indicate that they spend an average of approximately 30 hours per week away from home to attend school or day care. The total time a child spends at home, averaged over a 7-day week, is approximately 20 hours per day. It is assumed that residents spend 2 (RME) to 4 (CTE) weeks away from home on vacation or long holiday weekends. Therefore, the exposure frequency in real time is 335 days per year (CTE) to 350 days per year (RME). Because the contact rate for ingestion and dermal exposure is in daily units, the exposure frequency for these pathways is prorated into 24-hour-day equivalents. This ranges from 216 days per year (CTE adult) to 276 days per year (CTE child) and from 273 days per year (RME adult) to 288 days per year (RME child) (see Appendix L). Years spent at one residence for the adult/child range from 8 (CTE) to 30 (RME) years based on studies compiled by the USEPA (1989c) and AIHC (1994). Specific parameters relating to ingestion, contact, ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

In addition to the pathways discussed above, for the potential on-site adult resident at SWMU 22, the ingestion of groundwater pathway was separately evaluated. It is assumed that adults drink between 1.4 to 2 liters per day of well water associated with SWMU 22. Other parameters such as exposure frequency, duration, and body weight are the same as discussed above.

Based on the future usage of SWMU 22, it is possible that industrial construction may be conducted to increase the capacity of the military operations at TEAD-N. For these reasons, the future construction worker scenario was evaluated. It is assumed that a construction company could be contracted for a work period ranging from 1 to 3 years and a single worker could be at the site conducting activities outdoors from 2 to 4 months of the year. It is assumed that a worker works as much as 8 to 10 hours per day and may incidentally ingest, inhale, or come in contact with subsurface soil through construction-related activities. Specific parameters relating to ingestion, contact, ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

5.4.4.4.3 *Exposure Point Concentrations*. The EPC is defined as the concentration of a COPC in an exposure medium that will be contacted over a real or hypothetical exposure duration. EPCs at SWMU 22 were evaluated for current and future land use. Estimation of EPCs is fully described in Appendix L. For brevity, only information specific to SWMU 22 is presented in the following sections.

Current Land Use. EPCs for surface soil ingestion and dermal contact by the SWMU 22 personnel were estimated for the CTE and RME exposure scenario from Phase I and II RI data. EPCs in air for on-site personnel were estimated using USEPA's SCREEN2 model. Details of the estimation of emission rates from surface soils and dispersion modeling are described in Appendix N. Table 5-120 present the EPCs for on-site personnel.

Future Land Use. EPCs for incidental subsurface soil ingestion and dermal contact by hypothetical future construction workers at SWMU 22 were estimated for the CTE and RME exposure scenario with data from Phase I and II RI data. The EPCs for the COPC in subsurface soils at SWMU 22 are presented in Table 5-120.

EPCs for surface soil ingestion, dermal contact, produce ingestion, and ingestion of groundwater by hypothetical future on-site residents at SWMU 22 were estimated using methods described in Appendix L. The EPCs are given in Tables 5-120 and 5-121.

EPCs in air for on-site construction workers and residents were estimated using USEPA's SCREEN2 model. Details of the estimation of emission rates from surface and subsurface soils and dispersion modeling are described in Appendix N. Tables 5-120 and 5-121 presents the EPCs for on-site workers and residents at SWMU 22.

5.4.4.4.4 *Estimation of Chemical Intakes*. The exposure models described in detail in Appendix L together with EPCs listed in Tables 5-120 and 5-121 were used to estimate intake for the potential exposure scenarios. Note that averaging time differs for carcinogens and noncarcinogens. Estimates of exposure intakes are given in Tables 5-122 through 5-131 in Section 5.4.4.5.

Table 5-120. Adult Exposure Point Concentrations for SWMU 22

	Exposure Point Concentration	
Chemical	**CTE**	**RME**
Current Land Use		
Surface Soil (mg/kg)		
RDX	127.8	127.8
1,3,5-Trinitrobenzene	0.968	0.968
2,4,6-Trinitrotoluene	9,992	9,992
Air Emissions ($\mu g/m^3$)		
RDX	0.00051	0.00051
1,3,5-Trinitrobenzene	0.0000087	0.0000087
2,4,6-Trinitrotoluene	0.022	0.022
Future Land Use [a]		
Surface Soil (mg/kg)[b]		
Air Emissions from Surface Soil ($\mu g/m^3$)[b]		
Subsurface Soil (mg/kg)		
Chromium	56.9	56.9
2,4,6-Trinitrotoluene	65.7	65.7
Air Emissions from Subsurface Soil ($\mu g/m^3$)		
Chromium	0.045	0.045
2,4,6-Trinitrotoluene	0.052	0.052
Tubers/Fruits (mg/kg)		
RDX	10,800	10,800
1,3,5-Trinitrobenzene	12.9	12.9
2,4,6-Trinitrotoluene	133,000	133,000
Leafy Vegetables (mg/kg)		
RDX	308	308
1,3,5-Trinitrobenzene	0.37	0.37
2,4,6-Trinitrotoluene	3,810	3,810
Groundwater (mg/L)		
HMX	0.035	0.035
RDX	0.42	0.42

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.
[b]Future use concentrations are the same as for the current use scenario.

Table 5-121. Child Exposure Point Concentrations for SWMU 22

	Exposure Point Concentration	
Chemical	**CTE**	**RME**
Future Land Use [(a)]		
Surface Soil (mg/kg)		
RDX	127.8	127.8
1,3,5-Trinitrobenzene	0.968	0.968
2,4,6-Trinitrotoluene	9,992	9,992
Air Emissions ($\mu g/m^3$)		
RDX	0.00051	0.00051
1,3,5-Trinitrobenzene	0.0000087	0.0000087
2,4,6-Trinitrotoluene	0.022	0.022
Tubers/Fruits (mg/kg)		
RDX	10,800	10,800
1,3,5-Trinitrobenzene	12.9	12.9
2,4,6-Trinitrotoluene	133,000	133,000
Leafy Vegetables (mg/kg)		
RDX	308	308
1,3,5-Trinitrobenzene	0.37	0.37
2,4,6-Trinitrotoluene	3,810	3,810

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Table 5-122. Summary of Potential Carcinogenic Risk Results for the Current/Future On-site Laborer for SWMU 22

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
RDX	1.3E+02	1.2E-08	1.1E-01	1.3E-09	
1,3,5-Trinitrobenzene	9.7E-01	NA(d)	NA	NA	
2,4,6-Trinitrotoluene	1.0E+04	9.5E-07	3.0E-02	2.9E-08	
			Pathway Total:	3.0E-08	51%
Dermal Contact with Surface Soil					
RDX	1.3E+02	6.1E-09	1.1E-01	6.7E-10	
1,3,5-Trinitrobenzene	9.7E-01	NA	NA	NA	
2,4,6-Trinitrotoluene	1.0E+04	4.8E-07	6.0E-02	2.9E-08	
			Pathway Total:	2.9E-08	49%
Inhalation of Particulates					
RDX	5.1E-07	NA(d)	NA	NA	
1,3,5-Trinitrobenzene	8.7E-09	NA	NA	NA	
2,4,6-Trinitrotoluene	2.2E-05	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE ILCR:	5.9E-08	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
RDX	1.3E+02	9.7E-06	1.1E-01	1.1E-06	
1,3,5-Trinitrobenzene	9.7E-01	NA	NA	NA	
2,4,6-Trinitrotoluene	1.0E+04	7.6E-04	3.0E-02	2.3E-05	
			Pathway Total:	2.4E-05	31%
Dermal Contact with Surface Soil					
RDX	1.3E+02	1.1E-05	1.1E-01	1.2E-06	
1,3,5-Trinitrobenzene	9.7E-01	NA	NA	NA	
2,4,6-Trinitrotoluene	1.0E+04	8.8E-04	6.0E-02	5.3E-05	
			Pathway Total:	5.4E-05	69%
Inhalation of Particulates					
RDX	5.1E-07	NA	NA	NA	
1,3,5-Trinitrobenzene	8.7E-09	NA	NA	NA	
2,4,6-Trinitrotoluene	2.2E-05	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME ILCR:	7.8E-05	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-123. Summary of Potential Carcinogenic Risk Results for the Future On-Site Adult Resident for SWMU 22

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
RDX	1.3E+02	1.1E-06	1.1E-01	1.2E-07	
1,3,5-Trinitrobenzene	9.7E-01	NA(d)	NA	NA	
2,4,6-Trinitrotoluene	1.0E+04	8.8E-05	3.0E-02	2.6E-06	
			Pathway Total:	2.8E-06	0.003%
Dermal Contact with Surface Soil					
RDX	1.3E+02	5.6E-07	1.1E-01	6.2E-08	
1,3,5-Trinitrobenzene	9.7E-01	NA	NA	NA	
2,4,6-Trinitrotoluene	1.0E+04	4.4E-05	6.0E-02	2.6E-06	
			Pathway Total:	2.7E-06	0.003%
Inhalation of Particulates					
RDX	5.1E-07	NA	NA	NA	
1,3,5-Trinitrobenzene	8.7E-09	NA	NA	NA	
2,4,6-Trinitrotoluene	2.2E-05	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
RDX	3.1E+02	4.3E-03	1.1E-01	4.7E-04	
1,3,5-Trinitrobenzene	3.7E-01	NA	NA	NA	
2,4,6-Trinitrotoluene	3.8E+03	5.3E-02	3.0E-02	1.6E-03	
			Pathway Total:	2.1E-03	2.543%
Ingestion of Tubers and Fruits					
RDX	1.1E+04	5.4E-01	1.1E-01	6.0E-02	
1,3,5-Trinitrobenzene	1.3E+01	NA	NA	NA	
2,4,6-Trinitrotoluene	1.3E+04	6.7E-01	3.0E-02	2.0E-02	
			Pathway Total:	8.0E-02	97.451%
			Total CTE ILCR:	8.2E-02	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
RDX	1.3E+02	2.7E-05	1.1E-01	2.9E-06	
1,3,5-Trinitrobenzene	9.7E-01	NA	NA	NA	
2,4,6-Trinitrotoluene	1.0E+04	2.1E-03	3.0E-02	6.2E-05	
			Pathway Total:	6.5E-05	0.01%
Dermal Contact with Surface Soil					
RDX	1.3E+02	3.1E-05	1.1E-01	3.4E-06	
1,3,5-Trinitrobenzene	9.7E-01	NA	NA	NA	
2,4,6-Trinitrotoluene	1.0E+04	2.4E-03	6.0E-02	1.5E-04	
			Pathway Total:	1.5E-04	0.01%
Inhalation of Particulates					
RDX	5.1E-07	NA	NA	NA	
1,3,5-Trinitrobenzene	8.7E-09	NA	NA	NA	
2,4,6-Trinitrotoluene	2.2E-05	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
RDX	3.1E+02	6.0E-02	1.1E-01	6.6E-03	
1,3,5-Trinitrobenzene	3.7E-01	NA	NA	NA	
2,4,6-Trinitrotoluene	3.8E+03	7.5E-01	3.0E-02	2.2E-02	
			Pathway Total:	2.9E-02	2.71%
Ingestion of Tubers and Fruits					
RDX	1.1E+04	7.1E+00	1.1E-01	7.8E-01	
1,3,5-Trinitrobenzene	1.3E+01	NA	NA	NA	
2,4,6-Trinitrotoluene	1.3E+04	8.8E+00	3.0E-02	2.6E-01	
			Pathway Total:	1.0E+00	97.27%
			Total RME ILCR:	1.1E+00	100%

[a]Units for the inhalation pathway are mg/m3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-124. Summary of Potential Carcinogenic Risk Results for the Ingestion of Groundwater Pathway by the Future On-site Adult Resident for SWMU 22

Chemical	Exposure Point Concentration (mg/L)	Daily Carcinogenic Intake[a] (mg/kg-day)	Carcinogenic Slope Factor[b] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
<u>*Ingestion of Groundwater*</u>					
HMX	3.5E-02	NA[c]	NA	NA	
RDX	4.2E-01	5.2E-04	1.1E-01	5.7E-05	
			Total CTE ILCR:	5.7E-05	100%
Reasonable Maximum Exposure (RME) Scenario					
<u>*Ingestion of Groundwater*</u>					
HMX	3.5E-02	NA	NA	NA	
RDX	4.2E-01	3.5E-03	1.1E-01	3.9E-04	
			Total RME ILCR:	3.9E-04	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.

[b]See Appendix M for sources and methodology of toxicity values.

[c]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-125. Summary of Potential Carcinogenic Risk Results for the Future On-site Child Resident for SWMU 22

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
RDX	1.3E+02	5.1E-06	1.1E-01	5.6E-07	
1,3,5-Trinitrobenzene	9.7E-01	NA[d]	NA	NA	
2,4,6-Trinitrotoluene	1.0E+04	4.0E-04	3.0E-02	1.2E-05	
			Pathway Total:	1.2E-05	0.009%
Dermal Contact with Surface Soil					
RDX	1.3E+02	9.4E-07	1.1E-01	1.0E-07	
1,3,5-Trinitrobenzene	9.7E-01	NA	NA	NA	
2,4,6-Trinitrotoluene	1.0E+04	7.4E-05	6.0E-02	4.4E-06	
			Pathway Total:	4.5E-06	0.003%
Inhalation of Particulates					
RDX	5.1E-07	NA	NA	NA	
1,3,5-Trinitrobenzene	8.7E-09	NA	NA	NA	
2,4,6-Trinitrotoluene	2.2E-05	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
RDX	3.1E+02	7.5E-03	1.1E-01	8.2E-04	
1,3,5-Trinitrobenzene	3.7E-01	NA	NA	NA	
2,4,6-Trinitrotoluene	3.8E+03	9.3E-02	3.0E-02	2.8E-03	
			Pathway Total:	3.6E-03	2.711%
Ingestion of Tubers and Fruits					
RDX	1.1E+04	8.8E-01	1.1E-01	9.7E-02	
1,3,5-Trinitrobenzene	1.3E+01	NA	NA	NA	
2,4,6-Trinitrotoluene	1.3E+04	1.1E+00	3.0E-02	3.2E-02	
			Pathway Total:	1.3E-01	97.276%
			Total CTE ILCR:	1.3E-01	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
RDX	1.3E+02	5.7E-05	1.1E-01	6.2E-06	
1,3,5-Trinitrobenzene	9.7E-01	NA	NA	NA	
2,4,6-Trinitrotoluene	1.0E+04	4.4E-03	3.0E-02	1.3E-04	
			Pathway Total:	1.4E-04	0.02%
Dermal Contact with Surface Soil					
RDX	1.3E+02	1.3E-05	1.1E-01	1.4E-06	
1,3,5-Trinitrobenzene	9.7E-01	NA	NA	NA	
2,4,6-Trinitrotoluene	1.0E+04	1.0E-03	6.0E-02	6.1E-05	
			Pathway Total:	6.2E-05	0.01%
Inhalation of Particulates					
RDX	5.1E-07	NA	NA	NA	
1,3,5-Trinitrobenzene	8.7E-09	NA	NA	NA	
2,4,6-Trinitrotoluene	2.2E-05	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
RDX	3.1E+02	4.0E-02	1.1E-01	4.4E-03	
1,3,5-Trinitrobenzene	3.7E-01	NA	NA	NA	
2,4,6-Trinitrotoluene	3.8E+03	4.9E-01	3.0E-02	1.5E-02	
			Pathway Total:	1.9E-02	2.71%
Ingestion of Tubers and Fruits					
RDX	1.1E+04	4.7E+00	1.1E-01	5.1E-01	
1,3,5-Trinitrobenzene	1.3E+01	NA	NA	NA	
2,4,6-Trinitrotoluene	1.3E+04	5.7E+00	3.0E-02	1.7E-01	
			Pathway Total:	6.9E-01	97.26%
			Total RME ILCR:	7.0E-01	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-126. Summary of Potential Carcinogenic Risk Results for the Future Construction Worker for SWMU 22

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Subsurface Soil					
Chromium	5.7E+01	NA(d)	NA	NA	
2,4,6-Trinitrotoluene	6.6E+01	4.8E-07	3.0E-02	1.4E-08	
			Pathway Total:	1.4E-08	7%
Dermal Contact with Subsurface Soil					
Chromium	5.7E+01	NA	NA	NA	
2,4,6-Trinitrotoluene	6.6E+01	1.7E-08	6.0E-02	1.0E-09	
			Pathway Total:	1.0E-09	1%
Inhalation of Particulates					
Chromium	4.5E-05	4.4E-09	4.2E+01	1.9E-07	
2,4,6-Trinitrotoluene	5.2E-05	NA	NA	NA	
			Pathway Total:	1.9E-07	92%
			Total CTE ILCR:	2.0E-07	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Subsurface Soil					
Chromium	5.7E+01	NA	NA	NA	
2,4,6-Trinitrotoluene	6.6E+01	6.7E-06	3.0E-02	2.0E-07	
			Pathway Total:	2.0E-07	7%
Dermal Contact with Subsurface Soil					
Chromium	5.7E+01	NA	NA	NA	
2,4,6-Trinitrotoluene	6.6E+01	1.2E-06	6.0E-02	7.1E-08	
			Pathway Total:	7.1E-08	3%
Inhalation of Particulates					
Chromium	4.5E-05	5.8E-08	4.2E+01	2.4E-06	
2,4,6-Trinitrotoluene	5.2E-05	NA	NA	NA	
			Pathway Total:	2.4E-06	90%
			Total RME ILCR:	2.7E-06	100%

[a] Units for the inhalation pathway are mg/m^3.

[b] See Appendix L for sources and methodology on estimating a daily intake value.

[c] See Appendix M for sources and methodology of toxicity values.

[d] NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-127. Summary of Potential Systemic Effects for the Current/Future On-Site Laborer for SWMU 22

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
RDX	1.3E+02	3.0E-07	3.0E-03	1.0E-04	
1,3,5-Trinitrobenzene	9.7E-01	2.3E-09	5.0E-04	4.6E-06	
2,4,6-Trinitrotoluene	1.0E+04	2.4E-05	5.0E-04	4.8E-02	
			Pathway Total:	4.8E-02	50%
Dermal Contact with Surface Soil					
RDX	1.3E+02	1.5E-07	3.0E-03	5.1E-05	
1,3,5-Trinitrobenzene	9.7E-01	1.2E-09	2.5E-04	4.6E-06	
2,4,6-Trinitrotoluene	1.0E+04	1.2E-05	2.5E-04	4.8E-02	
			Pathway Total:	4.8E-02	50%
Inhalation of Particulates					
RDX	5.1E-07	NA(d)	NA	NA	
1,3,5-Trinitrobenzene	8.7E-09	NA	NA	NA	
2,4,6-Trinitrotoluene	2.2E-05	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	9.5E-02	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
RDX	1.3E+02	2.9E-05	3.0E-03	9.7E-03	
1,3,5-Trinitrobenzene	9.7E-01	2.2E-07	5.0E-05	4.4E-03	
2,4,6-Trinitrotoluene	1.0E+04	2.3E-03	5.0E-04	4.6E+00	
			Pathway Total:	4.6E+00	30%
Dermal Contact with Surface Soil					
RDX	1.3E+02	3.4E-05	3.0E-03	1.1E-02	
1,3,5-Trinitrobenzene	9.7E-01	2.6E-07	2.5E-05	1.0E-02	
2,4,6-Trinitrotoluene	1.0E+04	2.6E-03	2.5E-04	1.1E+01	
			Pathway Total:	1.1E+01	70%
Inhalation of Particulates					
RDX	5.1E-07	NA	NA	NA	
1,3,5-Trinitrobenzene	8.7E-09	NA	NA	NA	
2,4,6-Trinitrotoluene	2.2E-05	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	1.5E+01	100%

[a] Units for the inhalation pathway are mg/m^3.

[b] See Appendix L for sources and methodology on estimating a daily intake value.

[c] See Appendix M for sources and methodology of toxicity values.

[d] NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-128. Summary of Potential Systemic Effects for the Future On-site Adult Resident for SWMU 22

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
RDX	1.3E+02	1.1E-05	3.0E-03	3.5E-03	
1,3,5-Trinitrobenzene	9.7E-01	8.0E-08	5.0E-05	1.6E-03	
2,4,6-Trinitrotoluene	1.0E+04	8.2E-04	5.0E-04	1.6E+00	
			Pathway Total:	1.6E+00	0.01%
Dermal Contact with Surface Soil					
RDX	1.3E+02	5.3E-06	3.0E-03	1.8E-03	
1,3,5-Trinitrobenzene	9.7E-01	4.0E-08	2.5E-05	1.6E-03	
2,4,6-Trinitrotoluene	1.0E+04	4.1E-04	2.5E-04	1.6E+00	
			Pathway Total:	1.6E+00	0.01%
Inhalation of Particulates					
RDX	5.1E-07	NA[d]	NA	NA	
1,3,5-Trinitrobenzene	8.7E-09	NA	NA	NA	
2,4,6-Trinitrotoluene	2.2E-05	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
RDX	3.1E+02	4.3E-02	3.0E-03	1.4E+01	
1,3,5-Trinitrobenzene	3.7E-01	5.2E-05	5.0E-05	1.0E+00	
2,4,6-Trinitrotoluene	3.8E+03	5.3E-01	5.0E-04	1.1E+03	
			Pathway Total:	1.1E+03	7.03%
Ingestion of Tubers and Fruits					
RDX	1.1E+04	5.1E+00	3.0E-03	1.7E+03	
1,3,5-Trinitrobenzene	1.3E+01	6.1E-03	5.0E-05	1.2E+02	
2,4,6-Trinitrotoluene	1.3E+04	6.3E+00	5.0E-04	1.3E+04	
			Pathway Total:	1.4E+04	92.95%
			Total CTE HI:	1.5E+04	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
RDX	1.3E+02	6.6E-05	3.0E-03	2.2E-02	
1,3,5-Trinitrobenzene	9.7E-01	5.0E-07	5.0E-05	1.0E-02	
2,4,6-Trinitrotoluene	1.0E+04	5.2E-03	5.0E-04	1.0E+01	
			Pathway Total:	1.0E+01	0.02%
Dermal Contact with Surface Soil					
RDX	1.3E+02	7.7E-05	3.0E-03	2.6E-02	
1,3,5-Trinitrobenzene	9.7E-01	5.8E-07	2.5E-05	2.3E-02	
2,4,6-Trinitrotoluene	1.0E+04	6.0E-03	2.5E-04	2.4E+01	
			Pathway Total:	2.4E+01	0.04%
Inhalation of Particulates					
RDX	5.1E-07	NA	NA	NA	
1,3,5-Trinitrobenzene	8.7E-09	NA	NA	NA	
2,4,6-Trinitrotoluene	2.2E-05	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
RDX	3.1E+02	1.5E-01	3.0E-03	5.0E+01	
1,3,5-Trinitrobenzene	3.7E-01	1.8E-04	5.0E-05	3.6E+00	
2,4,6-Trinitrotoluene	3.8E+03	1.9E+00	5.0E-04	3.7E+03	
			Pathway Total:	3.8E+03	7.00%
Ingestion of Tubers and Fruits					
RDX	1.1E+04	1.8E+01	3.0E-03	5.9E+03	
1,3,5-Trinitrobenzene	1.3E+01	2.1E-02	5.0E-05	4.3E+02	
2,4,6-Trinitrotoluene	1.3E+04	2.2E+01	5.0E-04	4.4E+04	
			Pathway Total:	5.0E+04	92.93%
			Total RME HI:	5.4E+04	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-129. Summary of Potential Systemic Effects for the Ingestion of Groundwater Pathway for the Future On-Site Adult Resident for SWMU 22

Chemical	Exposure Point Concentration (mg/L)	Daily Noncarcinogenic Intake(a) (mg/kg-day)	Chronic RfD(b) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Groundwater					
HMX	3.5E-02	4.0E-04	5.0E-02	8.0E-03	
RDX	4.2E-01	4.9E-03	3.0E-03	1.6E+00	
			Total CTE HI:	1.6E+00	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Groundwater					
HMX	3.5E-02	7.3E-04	5.0E-02	1.5E-02	
RDX	4.2E-01	8.8E-03	3.0E-03	2.9E+00	
			Total RME HI:	3.0E+00	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.

[b]See Appendix M for sources and methodology of toxicity values.

Table 5-130. Summary of Potential Systemic Effects for the Future On-site Child Resident for SWMU 22

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
RDX	1.3E+02	4.8E-05	3.0E-03	1.6E-02	
1,3,5-Trinitrobenzene	9.7E-01	3.6E-07	5.0E-05	7.2E-03	
2,4,6-Trinitrotoluene	1.0E+04	3.7E-03	5.0E-04	7.4E+00	
			Pathway Total:	7.5E+00	0.03%
Dermal Contact with Surface Soil					
RDX	1.3E+02	8.8E-06	3.0E-03	2.9E-03	
1,3,5-Trinitrobenzene	9.7E-01	6.7E-08	2.5E-05	2.7E-03	
2,4,6-Trinitrotoluene	1.0E+04	6.9E-04	2.5E-04	2.8E+00	
			Pathway Total:	2.8E+00	0.01%
Inhalation of Particulates					
RDX	5.1E-07	NA(d)	NA	NA	
1,3,5-Trinitrobenzene	8.7E-09	NA	NA	NA	
2,4,6-Trinitrotoluene	2.2E-05	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
RDX	3.1E+02	7.0E-02	3.0E-03	2.3E+01	
1,3,5-Trinitrobenzene	3.7E-01	8.4E-05	5.0E-05	1.7E+00	
2,4,6-Trinitrotoluene	3.8E+03	8.6E-01	5.0E-04	1.7E+03	
			Pathway Total:	1.8E+03	7.01%
Ingestion of Tubers and Fruits					
RDX	1.1E+04	8.3E+00	3.0E-03	2.8E+03	
1,3,5-Trinitrobenzene	1.3E+01	9.9E-03	5.0E-05	2.0E+02	
2,4,6-Trinitrotoluene	1.3E+04	1.0E+01	5.0E-04	2.0E+04	
			Pathway Total:	2.3E+04	92.95%
			Total CTE HI:	2.5E+04	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
RDX	1.3E+02	2.4E-04	3.0E-03	7.9E-02	
1,3,5-Trinitrobenzene	9.7E-01	1.8E-06	5.0E-05	3.6E-02	
2,4,6-Trinitrotoluene	1.0E+04	1.8E-02	5.0E-04	3.7E+01	
			Pathway Total:	3.7E+01	0.06%
Dermal Contact with Surface Soil					
RDX	1.3E+02	5.4E-05	3.0E-03	1.8E-02	
1,3,5-Trinitrobenzene	9.7E-01	4.1E-07	2.5E-05	1.6E-02	
2,4,6-Trinitrotoluene	1.0E+04	4.2E-03	2.5E-04	1.7E+01	
			Pathway Total:	1.7E+01	0.03%
Inhalation of Particulates					
RDX	5.1E-07	NA	NA	NA	
1,3,5-Trinitrobenzene	8.7E-09	NA	NA	NA	
2,4,6-Trinitrotoluene	2.2E-05	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
RDX	3.1E+02	1.7E-01	3.0E-03	5.5E+01	
1,3,5-Trinitrobenzene	3.7E-01	2.0E-04	5.0E-05	4.0E+00	
2,4,6-Trinitrotoluene	3.8E+03	2.0E+00	5.0E-04	4.1E+03	
			Pathway Total:	4.1E+03	7.02%
Ingestion of Tubers and Fruits					
RDX	1.1E+04	1.9E+01	3.0E-03	6.5E+03	
1,3,5-Trinitrobenzene	1.3E+01	2.3E-02	5.0E-05	4.6E+02	
2,4,6-Trinitrotoluene	1.3E+04	2.4E+01	5.0E-04	4.8E+04	
			Pathway Total:	5.5E+04	92.89%
			Total RME HI:	5.9E+04	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-131. Summary of Potential Systemic Effects for the Future Construction Worker for SWMU 22

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Subsurface Soil					
Chromium	5.7E+01	3.1E-05	2.0E-02	1.6E-03	
2,4,6-Trinitrotoluene	6.6E+01	3.6E-05	5.0E-04	7.2E-02	
			Pathway Total:	7.4E-02	93%
Dermal Contact with Subsurface Soil					
Chromium	5.7E+01	1.1E-07	1.0E-03	1.1E-04	
2,4,6-Trinitrotoluene	6.6E+01	1.3E-06	2.5E-04	5.1E-03	
			Pathway Total:	5.2E-03	7%
Inhalation of Particulates					
Chromium	4.5E-05	NA(d)	NA	NA	
2,4,6-Trinitrotoluene	5.2E-05	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	7.9E-02	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Subsurface Soil					
Chromium	5.7E+01	1.5E-04	2.0E-02	7.3E-03	
2,4,6-Trinitrotoluene	6.6E+01	1.7E-04	5.0E-04	3.4E-01	
			Pathway Total:	3.4E-01	74%
Dermal Contact with Subsurface Soil					
Chromium	5.7E+01	2.6E-06	1.0E-03	2.6E-03	
2,4,6-Trinitrotoluene	6.6E+01	3.0E-05	2.5E-04	1.2E-01	
			Pathway Total:	1.2E-01	26%
Inhalation of Particulates					
Chromium	4.5E-05	NA	NA	NA	
2,4,6-Trinitrotoluene	5.2E-05	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	4.7E-01	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

5.4.4.5 *Toxicity Assessment*

Information of the toxicological effects of carcinogenic and systemic toxicants are summarized in Appendix M. This toxicity assessment includes brief toxicity profiles on data listed in USEPA's IRIS database and published in HEAST (USEPA 1994c). These profiles describe the acute, chronic, and carcinogenic health effects associated with SWMU-related chemicals. Toxicity values for the COPCs associated with SWMU 22 are summarized in Tables 5-122 through 5-131 in the following section.

5.4.4.6 *Risk Characterization*

This section provides a characterization of the potential health risks associated with the intake of chemicals associated with SWMU 22. The risk characterization compares estimated potential ILCRs with reasonable levels of risk for potential carcinogens (see Section 3.1.4.1), and the estimated daily intake of systemic toxicants with appropriate reference levels. Some carcinogenic chemicals may also pose a systemic hazard, and these potential hazards are characterized as for other systemic toxicants.

5.4.4.6.1 ***Characterization of Potential Carcinogenic Risks.*** The general process used to select the COPCs associated with SWMU 22 is described in Section 3.1.1. COPC selection for SWMU 22 is described in Section 5.4.4.2. For current land use scenarios, RDX, 1,3,5-trinitrobenzene, and 2,4,6-trinitrotoluene were identified as COPCs. RDX and 2,4,6-trinitrotoluene are classified as possible human carcinogens and are the sole contributors to the carcinogenic risk estimates for current land use scenarios. For future land use scenarios, the COPCs include RDX, 1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, HMX, and chromium. RDX and 2,4,6-trinitrotoluene are classified as possible human carcinogens, while chromium (assumed hexavalent chromium) is a confirmed human carcinogen. These three COPCs are the only contributors to the carcinogenic risk estimates for future land use scenarios. Tables 5-120 and 5-121 list the COPCs and their associated media.

Current/Future On-site Laborer. The cumulative ILCR for all pathways is 7.8E-05 and 5.9E-08 for the RME and CTE scenarios, respectively. As summarized in Table 5-122, the driving pathway for the RME scenario is dermal contact with surface soil (69 percent) and ingestion of surface soil (51 percent) for the CTE scenario. Total ILCR for dermal contact with surface soil by laborers at SWMU 22 is 5.4E-05 and 2.9E-08 for the RME and CTE scenarios, respectively. The incidental ingestion of surface soil ILCR for the laborer ranges from 2.4E-05 to 3.0E-08 for the RME and CTE scenarios, respectively. An ILCR for the inhalation of particulates pathway was not estimated because carcinogenic slope factors for COPCs associated with SWMU 22 are not available at the time of this report. The main contributor to these risk estimates is 2,4,6-trinitrotoluene.

Future On-site Adult Resident. The cumulative ILCR for all pathways is 1.1E+00 and 8.2E-02 for the RME and CTE scenarios, respectively. As summarized in Table 5-123, the driving

pathway is ingestion of produce, both leafy vegetables, tubers, and fruits, which contribute greater than 99 percent of the estimated risk.

Incremental lifetime cancer risk attributed to ingestion of produce, such as homegrown tubers and fruits by adults, results in an estimated ILCR of 1.0E+00 and 8.2E-02 using RME and CTE parameters, respectively. Dermal contact with surface soil by adults during yard work, gardening, etc., results in an estimated ILCR of 1.5E-04 using RME conditions and 2.7E-06 using the CTE conditions. Ingestion of surface soil results in an estimated ILCR of 6.5E-05 and 2.8E-06 for the RME and CTE scenarios, respectively. An ILCR for the inhalation of particulates pathway was not estimated because carcinogenic slope factors for COPCs associated with SWMU 22 are not available at the time of this report. The main contributor to the estimated risk is RDX.

Evaluated separately from the soil and air pathways, ingestion of groundwater by potential on-site adult residents results in a ILCR of 3.9E-04 to 5.7E-05 for the RME and CTE scenario, respectively (Table 5-124). However, it should be noted that environmental degradation of RDX was not taken into account when estimating the EPC. It is also estimated that RDX will not reach the water table for at least 4 to 5 decades from this point in time, which exceeds the 30-year duration of the default RME residential scenario as provided by the USEPA (USEPA 1990). For these reasons, the RME and CTE ILCRs for the ingestion of groundwater pathway are very likely to be an overestimate of risk.

Future On-site Child Resident. The cumulative ILCR for all pathways is 7.0E-01 and 1.3E-01 for the RME and CTE scenarios, respectively. As summarized in Table 5-125, the driving pathway is ingestion of produce, both leafy vegetables, tubers, and fruits, which contributes greater than 99 percent of the estimated risk.

Incremental lifetime cancer risk attributed to ingestion of produce, such as homegrown tubers and fruits by children, results in an estimated ILCR of 7.0E-01 and 1.3E-01 using RME and CTE parameters, respectively. Dermal contact with surface soil by children during yard work, gardening, etc., results in an estimated ILCR of 6.2E-05 using RME conditions and 4.5E-06 using the CTE conditions. Ingestion of surface soil results in an estimated ILCR of 1.4E-04 and 1.2E-05 for the RME and CTE scenarios. An ILCR for the inhalation of particulates pathway was not estimated because carcinogenic slope factors for COPCs associated with SWMU 22 are not available at this time. The main contributor to the risk estimates is RDX.

Future Construction Worker. The cumulative ILCR for all pathways is 2.7E-06 and 2.0E-07 for the RME and CTE scenarios, respectively. As summarized in Table 5-126, the driving pathway is inhalation of particulates, which contributes greater than 90 percent of the estimated risk.

Total ILCR for inhalation of particulates by laborers at SWMU 22 is 2.4E-06 and 1.9E-07 for the RME and CTE scenarios, respectively. For the remaining pathways evaluated, incidental ingestion of and dermal contact with surface soil, the estimated ILCRs are below the lower limit of the target risk range. The main contributor to the risk estimates is

2,4,6-trinitrotoluene for all pathways except inhalation of particulates, where chromium is the only contributor. This is due to the lack of toxicity values for 2,4,6-trinitrotoluene in air.

5.4.4.6.2 ***Characterization of Potential Systemic Effects.*** The general process used to select the COPCs associated with SWMU 22 is described in Section 3.1.1. COPC selection for SWMU 22 is described in Section 5.4.4.2. For current land use scenarios, RDX, 1,3,5-trinitrobenzene, and 2,4,6-trinitrotoluene were identified as COPCs. For future land use scenarios, the COPCs include RDX, 1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, HMX, and chromium. Systemic effects were estimated for all COPCs associated with SWMU 22. An HI for the inhalation of particulates pathway was not estimated because noncarcinogenic inhalation reference doses for COPCs associated with SWMU 22 were not available at the time of this report. Tables 5-120 and 5-121 list the COPCs and their associated media.

Current/Future On-site Laborers. As summarized in Table 5-127, the summed HI for all pathways is 1.5E+01 and 9.5E-02 for the RME and CTE scenarios, respectively. The driving pathway is dermal contact with surface soil, contributing greater than 50 percent of the total HI.

The summed HI for dermal contact with surface soil by laborers at SWMU 22 is 1.1E+01 and 4.8E-02 for the RME and CTE scenarios, respectively. The incidental ingestion of surface soil HI for the laborer ranges from 4.6E+00 to 4.8E-02 for the RME and CTE scenarios, respectively. The main contributor to these risk estimates is 2,4,6-trinitrotoluene. An HI for the inhalation of particulates pathway was not estimated because noncarcinogenic inhalation reference doses for COPCs associated with SWMU 22 were not available at the time of this report.

Future On-site Adult Resident. As summarized in Table 5-128, the summed HI for all pathways is 5.4E+04 and 1.5E+04 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of produce which contributes greater than 99 percent of the total HI. The main contributor to the risk estimates is RDX.

Ingestion of produce, such as homegrown vegetables, tubers, and fruits by adults, results in an estimated HI of 5.4E+04 and 1.5E+04 using RME and CTE parameters, respectively. Dermal contact with surface soil by adults during yard work, gardening, etc., results in an estimated HI of 2.4E+01 using RME conditions and 1.6E+00 using the CTE conditions. Ingestion of surface soil results in an estimated HI of 1.0E+01 and 1.6E+00 for the RME and CTE scenarios. The main contributor to the estimated HI is 2,4,6-trinitrotoluene. An HI for the inhalation of particulates pathway was not estimated because noncarcinogenic inhalation reference doses for COPCs associated with SWMU 22 were not available at the time of this report.

Evaluated separately from the soil and air pathways, ingestion of groundwater by potential on-site adult residents results in an HI of 3.0E+00 to 1.6E+00 for the RME and CTE scenarios, respectively (Table 5-129). The primary contributor to these risk estimates is RDX.

However, it should be noted that environmental degradation of RDX was not taken into account when estimating the EPC. It is also estimated that RDX will not reach the water table for at least 4 to 5 decades from this point in time, which exceeds the 30-year duration of the default RME residential scenario as provided by the USEPA (USEPA 1990). For these reasons, the RME and CTE HIs for the ingestion of groundwater pathway are very likely to be an overestimate of risk.

Future On-site Child Resident. As summarized in Table 5-130, the summed HI for all pathways is 5.9E+04 and 2.5E+04 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of produce, which contributes greater than 99 percent of the total HI. The primary contributor to these risk estimates is RDX.

Ingestion of produce, such as homegrown vegetables, tubers, and fruits by children, results in an estimated HI of 5.9E+04 and 2.5E+04 using RME and CTE parameters, respectively. Dermal contact with surface soil by children during yard work, playing, etc., results in an estimated HI of 1.7E+01 using RME conditions and 2.8E+00 using the CTE conditions. Ingestion of surface soil results in an estimated HI of 3.7E+01 and 7.5E+00 for the RME and CTE scenarios. The primary contributor to these risk estimates is 2,4,6-trinitrotoluene. An HI for the inhalation of particulates pathway was not estimated because noncarcinogenic inhalation reference doses for COPCs associated with SWMU 22 were not available at the time of this report.

Future Construction Worker. As summarized in Table 5-131, the summed HI for the RME and CTE scenario are not above unity (one). The summed HI for the RME and CTE scenario is 4.7E-01 and 7.9E-02, respectively. An HI for the inhalation of particulates pathway was not estimated because noncarcinogenic inhalation reference doses for COPCs associated with SWMU 22 were not available at the time of this report. The driving pathway is ingestion of surface soil, which contributes greater than 74 percent of the estimated risk.

5.4.4.7 *Risk Assessment Summary and Conclusions*

An RA was conducted for the Building 1304 Washout Pond based on Phase I and Phase II RI data. Three current- and future-use scenarios were quantitatively evaluated:

- On-site laborer/security worker
- On-site residents (redevelopment)
- Construction worker (during redevelopment)

For the current/future on-site laborer/security worker, all scenarios were found to fall within or below the target risk range of 1E-04 to 1E-06 for the ILCR. For the RME scenario, a summed HI of 1.5E+01 was estimated for ingestion and dermal contact with surface soil (see Tables 5-132 and 5-133). The main contributor to the HI is 2,4,6-trinitrotoluene. These risk results assume that the on-site laborer/security worker would be working at the same area of concern or SWMU for the entire length of service with no form of protection, such as gloves, masks, coveralls, etc. However, based on the job description for this receptor, continued

exposure to a single location is very unlikely. In addition, protective gear such as gloves, maks, coveralls, etc., were not taken into consideration when developing the exposure scenarios.

As summarized in Tables 5-132 and 5-133, risk results for both future on-site adult and child residents exceeded the target risk range of 10^{-4} to 10^{-6} for carcinogenic risk and unity for the HI. The total ILCRs for all pathways range from 1.1E+00 to 8.2E-02 and 7.0E-01 to 1.3E-01 for the adult and child RME and CTE scenarios, respectively. The same is true for the total HI. For the adult and child RME and CTE scenarios, the HI ranges from 5.4E+04 to 1.5E+04 and 5.9E+04 to 2.5E+04. The ingestion of produce pathway is the major contributor to the risk results.

Evaluated separately from the soil and air pathways, ingestion of groundwater by potential on-site adult residents results in a HI of 3.0E+00 to 1.6E+00 and an ILCR of 3.9E-04 and 5.7E-05 for the RME and CTE scenarios, respectively. However, it should be noted that environmental degradation of RDX was not taken into account when estimating the exposure point concentration. It is also estimated that RDX will not reach the water table for at least 4 to 5 decades from this point in time which exceeds the 30-year duration of the default RME residential scenario as provided by the USEPA (USEPA 1990). For these reasons, the RME and CTE HIs for the ingestion of groundwater pathway are very likely to be an overestimate of risk.

A construction worker scenario was evaluated to determine potential risks if redevelopment involving excavation occurs. For this scenario, an RME and a CTE were evaluated. Both scenarios were found to fall well below the target ranges for tolerable ILCRs and HIs.

It should be remembered that any estimate of risk is dependent on the concurrent validity of all assumptions used to construct the exposure model. In other words, the estimates rely on several activities recurring with constant intensity and in predictable order. For example, produce ingestion assumes a constant consumption rate every day for durations up to 30 years for adults and 18 years for children.

Food-chain pathways (i.e., home gardening) are significant contributors to total risks. According to Lee Sherry, a home economist with the Utah State University Agricultural Extension Service in Tooele, saline content in area soils generally require home gardeners and landscapers to replace or augment the existing soil with new topsoil. The above observation is confirmed by soil testing results from the Utah State University Soil Testing Laboratory (Appendix G).

EPCs for residential exposure are based on field data collected in the time frame 1992 through 1994. No residence currently exists on SWMU 22. If, at some future time, residences are built, the necessary construction activities would greatly alter the EPCs through the likely addition of fill and mixing.

Inhalation was quantitatively evaluated as if no vegetative cover and other residential landscaping would be present to eliminate significant wind erosion and particulate

Table 5-132. Summary of CTE Risk Results for SWMU 22

Scenario	SWMU as a Whole HI	SWMU as a Whole ILCR
Current Land Use		
On-site Laborer	9.5E-02	5.9E-08
Future Land Use		
On-site Adult Resident	1.5E+04	8.2E-02
On-site Child Resident	2.5E+04	1.3E-01
Construction Worker	7.9E-02	2.0E-07

Table 5-133. Summary of RME Risk Results for SWMU 22

Scenario	SWMU as a Whole HI	SWMU as a Whole ILCR
Current Land Use		
On-site Laborer	1.5E+01	7.8E-05
Future Land Use		
On-site Adult Resident	5.4E+04	1.1E+00
On-site Child Resident	5.9E+04	7.0E-01
Construction Worker	4.7E-01	2.7E-06

resuspension. Most of the current study area has vegetative cover.

When site-specific conditions are considered along with the conservative assumptions designed to offset assessment uncertainties, the risk estimates for the future residential scenario are, in point of fact, likely to be overestimates at a minimum. Under the current BRAC, SWMU 22 is not included in the parcel for potential release for private redevelopment. In fact, the mission of SWMU 22 is assumed to continue into the indefinite future. Based on the available analytical data and the above considerations, the risk assessment results indicate that there is no immediate and substantial danger to human health from the presence of low levels of hazardous chemicals at SWMU 22.

5.4.5 Conclusions and Recommendations

The Phase II RI sample analyte suite for Building 1303 Washout Pond (SWMU 22) consisted of metals, explosives, and cyanide. Cyanide was not detected in any surface or subsurface samples at SWMU 22. Sample results indicate metals were detected in both surface and subsurface soil at levels exceeding calculated background concentrations. A small area of explosives contamination adjacent to the concrete pad had high concentrations detected during both Phase I and Phase II. Explosives were also present in the small ponding area.

A baseline human health risk assessment was conducted at SWMU 22 to determine any potential human health risks associated with no-action alternative. Phase I and Phase II data were evaluated for use in the risk assessment and the resulting COPCs retained were 1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, and RDX for surface soil and 2,4,6-trinitrotoluene and chromium for subsurface soils. For the groundwater pathway, RDX and HMX were retained.

For the current land use scenario (on-site laborer), the CTE and RME ILCR was within or below the risk-based target range. The CTE HI was below unity (one), whereas the RME HI exceeded criteria (15) due primarily to ingestion of and dermal contact with the explosive 2,4,6-trinitrotoluene.

Similar results were estimated for the future use scenarios with total CTE HIs ranging from 67 for the future on-site adult resident to 110 for the future on-site child resident. These, however, were driven by ingestion of 2,4,6-trinitrotoluene in tubers and fruits.

Ecological risk results for SWMU 22 are presented in the SWERA (Rust E&I 1996).
On the basis of the contamination assessment and the human health risk assessment, a small area of explosives contamination adjacent to the washdown pad at Building 1303 poses a risk to human health and the environment. It is recommended that no further remedial investigations be conducted at SWMU 22. A feasibility study will be conducted for SWMU 22, as required by CERCLA, to determine the proper remedy or remedies for the SWMU. Removal of soils in the stained area adjacent to the concrete pad to the ponding area would likely reduce risks to acceptable levels. TEAD has submitted plans for a voluntary removal action of the explosive contaminated soils.

5.5 BOMB AND SHELL RECONDITIONING BUILDING (SWMU 23)

5.5.1 Site Characteristics

The Bomb and Shell Reconditioning Building (SWMU 23) is located in the western portion of TEAD-N and consists of Buildings 1343, 1344, and 1345 (see Figure 1-2). From the late 1950s to 1977, the main building, Building 1345, was used to conduct reconditioning of large munitions, including sandblasting and painting. Floor drains in Building 1345, located near the paint booths, discharged liquids from washdown operations to a ditch northeast of the building (Figure 5-14). Another discharge pipe and ditch are located southeast of Building 1344, south of the paved drive. The source of the liquid still discharged into this ditch is suspected to be boiler blowdown water from Building 1343. The two ditches parallel the road and then cross beneath the road via culverts to areas where the liquids are discharged to surface soils. Stained surface soils were observed where the two drain pipes discharge into the ditches. During a Phase I RI site visit in October 1991, Rust E&I personnel also observed several stained areas around the perimeter of the paved areas adjacent to the buildings. In addition, a pile of material containing metal cuttings, oil, and grease was observed behind Building 1343. Building 1343 houses a boiler that was used for hot-water or steam washing during the bomb and shell reconditioning process. Located behind Building 1343 is an underground storage tank (UST) containing diesel used for the boiler. Building 1345 is still in occasional use as a paint shop, and has been used recently for munitions-reconditioning projects.

5.5.2 Previous Investigations and Phase I and Phase II RI Activities

No environmental samples had been collected at SWMU 23 prior to the Phase I RI field activities. During a site visit by E.C. Jordan (1990a), two areas of surface staining were observed where the drain pipes discharged into the ditches that parallel the road. In addition, it was noted that areas of staining were also present on the paved surface adjacent to the main building (Building 1345). During the Phase I RI site visit by Rust E&I in October 1991, additional areas of staining were observed in the soils surrounding the perimeter of the paved area of the facility. To characterize these areas of surface staining and the areas of wastewater discharge, Rust E&I conducted surface soil sampling at nine locations around the pavement perimeter and downstream spreading areas during Phase I. Environmental sampling of the surface water (one sample) and sediment (two samples) was conducted in the ditches adjacent to the discharge pipes. The locations of these sampling points are shown in Figure 5-14. All samples were analyzed for SVOCs, metals, and anions. In addition, the two sediment samples and the surface water sample were analyzed for pesticides/PCBs. At the time of sampling, neither area of wastewater discharge was flowing. Five days later, however, the southernmost ditch contained flowing water from wastewater discharge, and a surface water sample was collected. All of the sampling conducted at SWMU 23 was biased with emphasis on areas of surface staining. This sampling approach was designed to identify areas of contaminant releases to environmental pathways. Therefore, the extent of contamination was not defined at

any of the sampling areas at SWMU 23 during the Phase I RI field activities. Photographs of SWMU 23 are provided in Appendix C.

Surface soil samples collected along the perimeter of Building 1345 and the paved area during Phase I contained primarily metals and anions, although SVOCs were detected in sample BRS-92-06 near Building 1343 (Figure 5-14). Sediment collected in the ditches and discharge areas contained metals, cyanide, and low levels of PCBs. Surface water collected from discharge to the southernmost ditch contained elevated VOCs, metals, and anions. From these Phase I RI results, it was determined that further investigation of SWMU 23 was necessary. The extent of contamination resulting from wastewater discharge was to be defined through soil sampling downstream from the discharge area east-northeast of the site. Additional surface soil samples were necessary to further define the horizontal extent of contamination along the perimeter of the paved area of the SWMU, and additional soil borings would determine the vertical extent of contamination throughout the SWMU.

Phase II RI field activities were performed by Rust E&I during the summer of 1994. Ten surface soil samples (0 to 6 inches) were collected from locations surrounding the facility, including the discharge areas, to further define the horizontal extent of contamination from the facility operations. Out of the 17 proposed soil borings at SWMU 23, 7 boring locations were replaced by test pits (BRP-94-01, -03, -06, -07, -08, -09, and -13) because of the presence of coarse gravels, cobbles, and boulders (Figure 5-15). Three 5-foot-deep boring locations (BRB-94-11, BRB-94-12, and BRB-94-14) and two test pits (BRP-94-08 and -09) were completed and sampled along the drainage ditches receiving facility discharge fluid. These sampling locations were designed to assess the vertical and horizontal extent of metals, cyanide, SVOCs, and PCB contaminants.

Three soil borings (BRB-94-02, -04, -05) and two test pits (BRP-94-06 and -13) were completed to 5 feet in the pavement area to further characterize the soils adjacent to Buildings 1345 and 1343 where staining was observed at the surface. Samples were collected at 0.5-, 3-, and 5-foot depths and analyzed for metals, SVOCs, cyanide, and PCBs. During the drilling of soil borings BRB-94-02 and -04, a petroleum-like odor was emitted from the split spoons recovered from 2 to 6 feet in boring BRB-94-02 and from 4 to 6 feet in boring BRB-94-04. The headspace readings collected from these split-spoon samples ranged from 5.2 to 14 ppm as measured with a field PID. Due to an oversight by the field investigation crew, no VOC samples were collected. The source of these odors and readings was not determined but may be associated with a UST located to the west of Building 1343. This UST was suspected of containing diesel fuel for the boiler inside Building 1345. However, upon inspection of the UST vault, there was no visible evidence of tank leakage. Surface staining on the concrete outside of the door on the northeast wall of Building 1343 was observed, and test pit BRP-94-13 was excavated through the asphalt adjacent to this location. While excavating test pit BRB-94-06, located between Building 1345 and the discharge pipe to the northeast, the backhoe broke a 6-inch terra-cotta tile pipe about 3.5 feet beneath the ground surface that possibly ran from the building to the discharge ditch. No liquid or other material was present in the pipe when it was broken. The TEAD Environmental Management Office confirmed that this pipeline is no longer in use and that it would be repaired and covered.

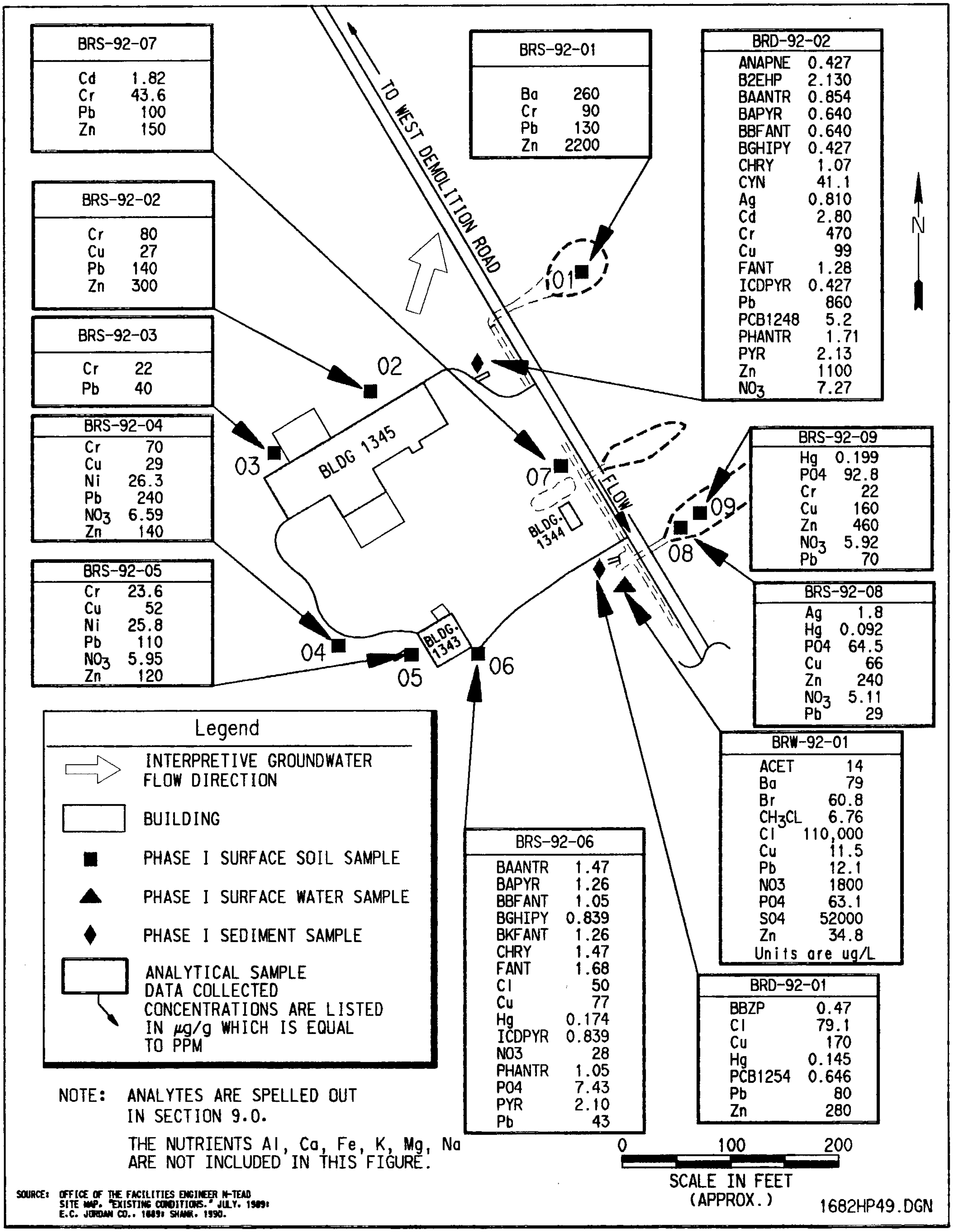

Figure 5-14. SWMU 23 Phase I Sample Locations and Results

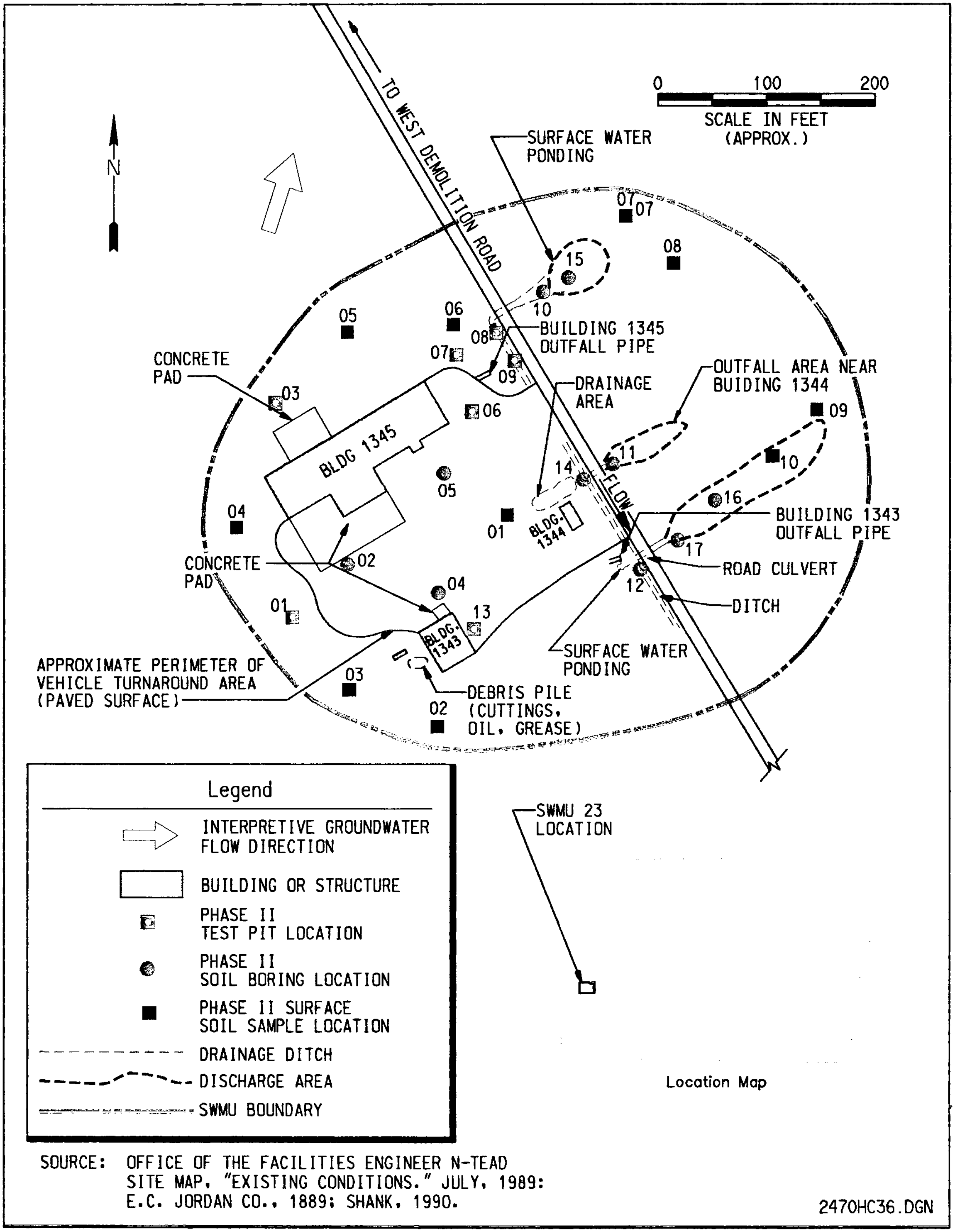

Figure 5-15. SWMU 23 Phase II Sample Locations

Two test pits located at the concrete pad northwest of Building 1345 (BRP-94-03) and adjacent to Phase I sample BRS-92-04 (BRP-94-01) were excavated to a depth of 5 feet in order to define the vertical extent of the previously identified metals and SVOC contamination. Metal debris was found scattered across the surface where test pits BRP-94-01 and -03 were excavated. Dried yellow and green paint residue was also present on the surface near test pit BRP-94-03, which was excavated on top of the berm north of the building. There is a ramp that leads to this location and allows for vehicle access; this may have facilitated dumping of materials on top of this berm. Test pit BRP-94-01 was located adjacent to a possible evaporative pan, consisting of a 1/8-inch-thick steel pan approximately 10 feet by 25 feet in size with 3-to-4-inch sides.

Two of the soil boring locations (BRB-94-12 and BRP-94-07) were drilled to a depth of 5 feet outside of the pavement area adjacent to previous sediment sample sites, BRD-92-01 and BRD-92-02, respectively, in order to investigate the vertical extent of SVOC and PCB contamination. Samples were collected at 0.5-, 3-, and 5-foot depths and analyzed for metals, SVOCs, cyanide, and PCBs.

A total of four soil borings, two in each discharge area on the northeast side of the road, were drilled to a depth of 5 feet. Samples were collected at 3 feet and 5 feet to address the possible vertical migration of contaminants from wastewater discharge. These eight samples were analyzed for metals, SVOCs, cyanide, and PCBs. Surface-soil samples from the drainage ditch and in the discharge areas on the northeast side of the road were analyzed for metals, SVOCs, cyanide, and PCBs.

5.5.3 Contamination Assessment

5.5.3.1 *Data Evaluation*

This section evaluates the analytical data for its usability in the risk assessment. A data evaluation was performed by reviewing the data quality codes assigned by the USAEC Chemistry Branch and EcoChem, an independent third-party validator. In an effort to ascertain the level of certainty/uncertainty, USEPA data qualification codes were then assigned as an aid in interpreting the data for use in the risk assessment. (Table 2-4 defines the relationship between the USAEC Chemistry Branch codes and USEPA data qualifiers.) The following sections summarize the results of this process.

5.5.3.1.1 ***Field Duplicates.*** The "D" flag code represents a field duplicate. All "D" flagged data were compared with the primary investigative result, and the higher of the two values was used in the quantitative risk assessment.

5.5.3.1.2 *Blank Assessment.* The USEPA has determined that when blank contamination exists, the investigative results must exceed the blank result by a factor of 5 (all compounds) or 10 (common laboratory contaminants such as acetone) in order to be considered positive. Acetone and methylene chloride, which are common laboratory contaminants, and several metals were detected in method and/or other blanks associated with SWMU 23 soil samples. Based on comparisons to blanks, positive results were changed to nondetects for the following samples. Per USEPA guidance (USEPA 1989a), the highest associated blank concentration was considered the quantitation limit for the affected samples.

- Building 1343 Outfall—Surface Soil
  - -Acetone—BRD-92-01, BRS-92-08
  - -Methylene chloride—BRD-92-01, BRS-92-08, and -09
  - -Mercury—BRB-94-12A
  - -Vanadium—BRB-94-12A

- Building 1343 Outfall—Subsurface Soil
  - -Aluminum—BRB-94-12C, -16B, -17A, and -17B
  - -Barium—BRB-94-12C, -17A, and -17B
  - -Iron—BRB-94-12C
  - -Manganese—BRB-94-12C, -16A, -16B, -17A, -17B
  - -Mercury—BRB-94-12B and -12C
  - -Potassium—BRB-94-12C, -16B, -17A, and -17B
  - -Vanadium—BRB-94-12C
  - -Zinc—BRB-94-12C, -16B, -17B

- Outfall Area Near Building 1344 - Surface Soil
  - -Methylene chloride—BRS-92-07

- Outfall Area Near Building 1344—Subsurface Soil
  - -Aluminum—BRB-94-11B, -11C, -14A, and -14B
  - -Barium—BRB-94-11B, -11C, -14A, and -14C
  - -Iron—BRB-94-14B
  - -Manganese—BRB-94-11B, -11C, -14A, and -14B
  - -Potassium—BRB-94-11B, -11C, -14A, -14B
  - -Vanadium—BRB-94-14A
  - -Zinc—BRB-94-11C, -14A, and -14B

- Building 1345 Outfall—Surface Soil
  - -Acetone—BRD-92-02
  - -Methylene chloride—BRD-92-02 and BRS-92-01
  - -Aluminum—BRP-94-08A and -09A
  - -Manganese—BRB-94-10A and BRP-94-08A
  - -Mercury—BRP-94-06A, -07A, -08A, and -09A (and duplicate)
  - -Nickel—BRP-94-06A
  - -Potassium—BRP-94-08A
  - -Vanadium—BRP-94-09A

- Building 1345 Outfall—Subsurface Soil
  - Aluminum—BRB-94-10B, -10C, -15A, -15B, BRP-94-09B (and duplicate), and -09C (and duplicate)
  - Barium—BRB-94-10B, -10C, -15B, BRP-94-06C, -07B, -07C, -08B, -08C, -09B (and duplicate), and -09C (and duplicate)
  - Chromium—BRP-94-07B and -07C
  - Iron—BRP-94-06C, -07C, -08B, and -09B
  - Manganese—BRB-94-10B, -10C, -15A, -15B, BRP-94-06C, -07B, -07C, -08B, -08C, -09B (and duplicate), and -09C (and duplicate)
  - Mercury—BRP-94-06B, -06C, -07B, -07C, -08B, -08C, -09B (and duplicate), and -09C (and duplicate)
  - Nickel—BRP-94-06B, and -06C
  - Potassium—BRB-94-10B, -10C, -15A, -15B, BRP-94-06C, -07C, -07C, -08B, -08C, -09B (and duplicate), and -09C (and duplicate)
  - Vanadium—BRP-94-06C, -07B, -07C, -08B, -09B (and duplicate), -09C (duplicate only)
  - Zinc—BRP-94-06C, -07B, -07C, and -08C

- Asphalt Area—Surface Soil
  - Acetone—BRS-92-06
  - Methylene chloride—BRS-92-06
  - Mercury—BRB-94-02A, -04A, -05A, BRP-94-13A
  - Nickel—BRB-94-94A and -05A
  - Potassium—BRS-94-01
  - Vanadium—BRB-94-02A, -04A, -05A, and -13A
  - Zinc—BRB-94-02A and -13A

- Asphalt Area—Subsurface Soil
  - Aluminum—BRB-94-02B, -02C, -04C, -05B, -05C, BRP-94-13B, and -13C
  - Barium—BRB-94-02B, -02C, -04C, -05C, BRP-94-13B and -13C
  - Chromium—BRP-94-13B and -13C
  - Iron—BRB-94-02B, -02C, -04C, -05C, BRP-94-13B, and -13C
  - Manganese—BRB-94-02B, -02C, -04C, -05B, -05C, BRP-94-13B, and -13C
  - Mercury—BRB-94-02B, -02C, -04B, -04C, -05B, -05C, BRP-94-13B, and -13C
  - Nickel—BRB-94-04B, -04C, -05B, and -5C
  - Potassium—BRB-94-02B, -02C, -04B, -05B, -05C, BRP-94-13B, and -13C
  - Vanadium—BRB-94-02C, -04B, -04C, BRP-94-13B, and -13C
  - Zinc—BRB-94-02B, -02C, -04C, -05C, BRP-94-13B, and -13C

- Perimeter Area—Surface Soil
  - Acetone—BRS-92-05
  - Methylene chloride—BRS-92-02, -03, -04, and -05
  - Mercury—BRP-94-01A and -03A

- Perimeter Area—Subsurface Soil
  -Aluminum—BRP-94-01B, -03B, and -03C
  -Barium—BRP-94-01B and -03C
  -Iron—BRP-94-03C
  -Manganese—BRP-94-01B and -03C
  -Mercury—BRP-94-01B, -01C, -03B, and -03C
  -Potassium—BRP-94-01B, -03B, and -03C
  -Vanadium—BRP-94-01B, -03B, and -03C
  -Zinc—BRP-94-01C, -03B, and -03C

5.5.3.1.3 ***USAEC Chemistry Branch Validation.*** The USAEC Chemistry Branch reviewed the analytical data for technical deficiencies based on the *USATHAMA (USAEC) Quality Assurance Program (PAM 11-41*). USAEC data qualifiers assigned by the Chemistry Branch would be an indication of QC recoveries outside of USAEC control limits and other technical deficiencies. Estimating the data for use in the risk assessment based on USAEC data qualifiers is judged to be a conservative approach since USAEC control limits are generally narrower than USEPA Functional Guidelines. For SWMU 23, no data were qualified based on the USAEC's review.

Non-Certified Compounds. USAEC flag codes of R or T were assigned by the analytical laboratory to indicate non-detected compounds that had not been performance demonstrated or validated under the USAEC's 1990 QA program. Under this program, a distinction is made between "target" and "non-target" analytes. "Target" compounds are determined during the certification process, and CRLs for these analytes are established. "Non-target" compounds are those which were added to the method to meet project-specific requirements. The lowest calibration standard typically reflects the PQL for that analyte. For the purpose of the risk assessment, the detection limit was assigned a J-code, due to the uncertainty associated with not having undergone a rigorous certification process.

5.5.3.1.4 ***Independent Third-Party Data Validation.*** A data quality assessment was completed using a validation effort by EcoChem, an independent third party. EcoChem's review and recommendations were based on USEPA Functional Guidelines as well as the *USATHAMA (USAEC) Quality Assurance Program (PAM 11-41*) and individual methods. All USEPA data qualifiers recommended by EcoChem were incorporated for use in the risk assessment and are provided in the analytical summary tables of Appendix J.

For SWMU 23, 1994 data, EcoChem evaluated one lot each of arsenic analyses by Method B9 (soil), PCB analyses by Method LH17 (soil), and ICP metals analyses by Method JS12 (soil).

For the arsenic analyses, Lot ANWH, and the PCB analyses, Lot ANVA, all data were judged to be acceptable for use without qualification.

For the ICP metals analyses, Lot ANWJ, all vanadium results less than the high spike concentration were qualified as estimated (J) and should be considered biased low by approximately 40 percent. All antimony detection limits were rejected because of zero antimony recovery in the natural (matrix) spikes.

For SWMU 23, 1992 data, EcoChem evaluated two lots of pesticides/PCB analyses of soil samples (Method LH13), one lot of pesticides/PCB analyses of water samples (Method UH16), and one lot of explosive analyses of soil samples (Method LW26). EcoChem judged all of the pesticides/PCB and explosive data reviewed for SWMU 23 to be acceptable for use without qualification.

Several SWMU 23 samples were reviewed for SVOC analyses of soil samples by Method LM25 as part of EcoChem's validation effort for SWMU 23. They qualified several samples as estimated (J or UJ) due to poor internal standard response, a parameter not checked under USAEC review (see EcoChem's Data Quality Assessment in Appendix J for a complete list of the associated analytes).

Two SWMU 23 samples were also reviewed for ICP metals analysis of soil samples as part of EcoChem's validation effort for SWMU 40. They recommended that antimony detection limits be rejected (R) due to MS/MSD recoveries. Beryllium, cadmium, and copper were qualified as estimated (J or UJ) also due to natural (matrix) spike recoveries.

Listed below are all sample results for SWMU 23 that were rejected for use in the risk assessment based on the above validation efforts.

- Surface Samples
  -Antimony—BRB-94-12A and BRP-94-01A, -02A, -03A, -07A, -09A, -13A, BRS-92-01, BRD-92-02

- Subsurface Samples
  -Antimony—BRB-94-12B, -12C and BRP-94-01B, -01C, -02B, -02C, -03B, -03C, -07B, -07C, -09B, -13B, -13C

5.5.3.1.5 ***Data Evaluation Summary.*** A total of 32 surface soil samples (and 1 duplicate), 2 sediment samples, and 34 subsurface soil samples (and 2 duplicates) were collected in 1992 and 1994 from 7 test pits, 10 soil borings, and 21 surface locations at SWMU 23. For risk assessment purposes, the two sediment samples were considered surface soil samples. Test pit and soil boring samples were collected at depths of 0, 3, and 5 feet. Samples were analyzed for one or more of the following groups of chemicals: volatiles, semivolatiles, anions, metals, explosives, and pesticides/PCBs.

Because of blank contamination, positive results for a number of metals were changed to nondetects. With the exception of mercury, the detected values in the affected samples were below background screening levels for the metals, indicating that this issue does not

significantly impact the risk assessment results. Mercury detections were above background for many samples that were converted to nondetects; however, the detected concentrations were below the ingestion and soil-to-air RBCs for mercury. Therefore, the issue of blank contamination with mercury does not significantly impact the risk assessment results.

Antimony and thallium were not detected in any surface or subsurface soil samples. The antimony and thallium reporting limits exceed the ingestion RBCs for these metals. Additionally, 29 antimony nondetect results were rejected due to poor matrix spike recoveries. Therefore, the magnitude and extent of antimony and thallium contamination may not be adequately characterized at this SWMU.

Reporting limits for cadmium (1.2 μg/g) and silver (0.80 μg/g) were above their respective background screening values but less than their respective ingestion and soil-to-air RBCs. Therefore, this issue does not significantly impact the risk assessment results.

Nondetect results for each of the following semivolatiles were rejected because the compounds were not included in the initial and continuing calibration standard: PCB 1016, PCB 1260, PCB 1262, and toxaphene. No detections of these compounds were reported using a methodology specifically for detecting pesticides and PCBs. Therefore, this issue does not significantly impact the risk assessment results for these chemicals.

Approximately 98 percent of sample results were judged to be usable for risk assessment purposes. The number of samples and the analytical parameter list appear to be sufficient to characterize the nature, extent, and potential magnitude of contamination at this SWMU with exceptions noted above. A summary of chemicals detected in at least one surface or subsurface soil sample at SWMU 23 is presented in Appendix J, including data qualifiers (as appropriate) according to USEPA functional guidelines.

5.5.3.1.6 ***Background Screening.*** The maximum concentrations of inorganic chemicals detected in soil within each area of concern at SWMU 23 were compared to the site-specific background screening values (see Section 2.6). Any inorganic chemical detected in at least one sample at a concentration higher than the background screening value was retained in the COPC database. Surface soil and subsurface soil were screened separately. The results of the background screening are shown in Table 5-134.

Building 1343 Outfall. Based on the background screening analysis, chromium, copper, iron, lead, mercury, silver, and zinc were retained as preliminary COPCs in surface soil at the Building 1343 Outfall. Cadmium was not detected in surface soil; however, the cadmium CRL (1.2 μg/g) was higher than the background screening value (0.847 μg/g). Thallium was not detected in surface soil at the Building 1343 Outfall, but the CRLs were higher than the background threshold value for thallium of 11.7 μg/g.

Table 5-134. Background Screening of Inorganic Chemicals Detected in Soil at SWMU 23

Chemical	Frequency of Detection[a]	Maximum Detected Value (μg/g)	Site-specific Background Screening Value[b] (μg/g)	Exceeds Site-specific Background?
Building 1343 Outfall - Surface Soil				
Aluminum	1/1	8,090	28,083	No
Arsenic	1/4	5.9	11.69	No
Barium	4/4	160	247	No
Calcium	1/1	69,000	114,483	No
Chromium	4/4	23.1	20.62	**YES**
Cobalt	1/1	3.74	6.94	No
Copper	4/4	170	24.72	**YES**
Iron	4/4	28,000	22,731	**YES**
Lead	4/4	80	18.23	**YES**
Magnesium	1/1	4,490	7,062	No
Manganese	1/1	248	698	No
Mercury	3/4	0.199	0.0572	**YES**
Nickel	2/4	8.42	17.40	No
Potassium	1/1	2,240	5,450	No
Silver	3/4	1.8	0.66	**YES**
Sodium	1/1	332	337	No
Zinc	3/3	460	102.8	**YES**
Building 1343 Outfall - Subsurface Soil				
Aluminum	2/6	8,100	28,083	No
Arsenic	6/6	5.34	11.69	No
Barium	3/6	78.2	247	No
Cadmium	1/6	2.24	0.847	**YES**
Calcium	6/6	36,800	114,483	No
Chromium	6/6	54.6	20.62	**YES**
Cobalt	6/6	5.83	6.94	No
Copper	6/6	20.6	24.72	No
Iron	5/6	13,800	22,731	No
Lead	3/6	31	18.23	**YES**
Magnesium	6/6	4,730	7,062	No
Manganese	1/6	224	698	No
Mercury	1/6	0.0535	0.0572	No
Nickel	6/6	9.86	17.40	No
Potassium	2/6	2,050	5,450	No
Silver	3/6	5.05	0.66	**YES**
Sodium	6/6	445	337	**YES**
Vanadium	5/6	23.8	28.39	No
Zinc	3/6	44.9	102.8	No
Outfall Area Near Building 1344 - Surface Soil				
Aluminum	1/1	5,560	28,083	No
Arsenic	1/2	5.65	11.69	No

Table 5-134. Background Screening of Inorganic Chemicals Detected in Soil at SWMU 23 (continued)

Chemical	Frequency of Detection[a]	Maximum Detected Value (μg/g)	Site-specific Background Screening Value[b] (μg/g)	Exceeds Site-specific Background?
Barium	2/2	57.2	247	No
Cadmium	2/2	2.66	0.847	**YES**
Calcium	1/1	19,100	114,483	No
Chromium	2/2	43.6	20.62	**YES**
Cobalt	1/1	3.45	6.94	No
Copper	2/2	18.1	24.72	No
Iron	2/2	9,850	22,731	No
Lead	2/2	115	18.23	**YES**
Magnesium	1/1	3,120	7,062	No
Manganese	1/1	169	698	No
Nickel	2/2	7.64	17.40	No
Potassium	1/1	1,270	5,450	No
Silver	1/2	0.0737	0.66	No
Sodium	1/1	143	337	No
Vanadium	1/1	12.8	28.39	No
Zinc	2/2	150	102.8	**YES**
Outfall Area Near Building 1344 - Subsurface Soil				
Arsenic	4/4	5.81	11.69	No
Calcium	4/4	48,500	114,483	No
Chromium	4/4	537	20.62	**YES**
Cobalt	1/4	3.81	6.94	No
Copper	4/4	11.8	24.72	No
Iron	3/4	11,700	22,731	No
Lead	3/4	13.6	18.23	No
Magnesium	4/4	2,780	7,062	No
Mercury	1/4	0.0596	0.0572	**YES**
Nickel	4/4	19.8	17.40	**YES**
Sodium	4/4	249	337	No
Vanadium	3/4	21.2	28.39	No
Zinc	1/4	19.6	102.8	No
Building 1345 Outfall - Surface Soil				
Aluminum	5/6	11,100	28,083	No
Arsenic	6/8	6.98	11.69	No
Barium	8/8	260	247	**YES**
Cadmium	5/8	52.4	0.847	**YES**
Calcium	6/6	39,100	114,483	No
Chromium	8/8	470	20.62	**YES**
Cobalt	6/6	10.5	6.94	**YES**
Copper	8/8	99	24.72	**YES**
Cyanide	4/8	41.1	5	**YES**
Iron	8/8	35,000	22,731	**YES**

Table 5-134. Background Screening of Inorganic Chemicals Detected in Soil at SWMU 23 (continued)

Chemical	Frequency of Detection[a]	Maximum Detected Value (μg/g)	Site-specific Background Screening Value[b] (μg/g)	Exceeds Site-specific Background?
Lead	8/8	860	18.23	**YES**
Magnesium	6/6	6,580	7,062	No
Manganese	4/6	396	698	No
Nickel	6/8	16	17.40	No
Potassium	5/6	3,080	5,450	No
Silver	2/8	0.810	0.66	**YES**
Sodium	6/6	352	337	**YES**
Vanadium	6/6	23.1	28.39	No
Zinc	7/7	2,200	102.8	**YES**
Building 1345 Outfall - Subsurface Soil				
Aluminum	1/12	6,470	28,083	No
Arsenic	12/12	8.21	11.69	No
Barium	2/12	54.8	247	No
Calcium	12/12	36,600	114,483	No
Chromium	10/12	66.6	20.62	**YES**
Cobalt	3/12	3.49	6.94	No
Copper	12/12	16.2	24.72	No
Iron	9/12	12,700	22,731	No
Lead	6/12	21.8	18.23	**YES**
Magnesium	12/12	3,930	7,062	No
Manganese	1/12	158	698	No
Mercury	1/12	0.0551	0.0572	No
Nickel	10/12	30	17.40	**YES**
Potassium	1/12	1,460	5,450	No
Sodium	12/12	396	337	**YES**
Vanadium	7/12	20	28.39	No
Zinc	8/12	46.4	102.8	No
Asphalt Area and Stained Areas - Surface Soil				
Aluminum	5/5	7,900	28,083	No
Arsenic	5/6	5.94	11.69	No
Barium	6/6	79.7	247	No
Calcium	5/5	46,300	114,483	No
Chromium	6/6	162	20.62	**YES**
Cobalt	4/5	3.75	6.94	No
Copper	6/6	77	24.72	**YES**
Iron	6/6	23,000	22,731	**YES**
Lead	4/6	43	18.23	**YES**
Magnesium	5/5	5,930	7,062	No
Manganese	5/5	227	698	No
Mercury	1/6	0.174	0.0572	**YES**
Nickel	3/6	7.47	17.40	No

Table 5-134. Background Screening of Inorganic Chemicals Detected in Soil at SWMU 23 (continued)

Chemical	Frequency of Detection[a]	Maximum Detected Value (μg/g)	Site-specific Background Screening Value[b] (μg/g)	Exceeds Site-specific Background?
Potassium	4/5	2,070	5,450	No
Silver	1/6	0.0615	0.66	No
Sodium	5/5	336	337	No
Vanadium	1/5	8.14	28.39	No
Zinc	4/6	76	102.8	No
Asphalt Area and Stained Areas - Subsurface Soil				
Aluminum	1/8	7,290	28,083	No
Arsenic	6/8	7.22	11.69	No
Barium	1/8	68.7	247	No
Calcium	8/8	95,000	114,483	No
Chromium	6/8	116	20.62	**YES**
Cobalt	4/8	5.41	6.94	No
Copper	7/8	14	24.72	No
Iron	2/8	11,300	22,731	No
Lead	2/8	14	18.23	No
Magnesium	8/8	4,790	7,062	No
Manganese	1/8	167	698	No
Nickel	3/8	7.34	17.40	No
Potassium	1/8	1,910	5,450	No
Silver	1/8	1.39	0.66	**YES**
Sodium	8/8	252	337	No
Vanadium	3/8	47.2	28.39	**YES**
Zinc	2/8	23.1	102.8	No
Perimeter Area - Surface Soil				
Aluminum	10/10	13,600	28,083	No
Arsenic	10/14	7.17	11.69	No
Barium	14/14	143	247	No
Beryllium	2/14	0.573	1.46	No
Cadmium	1/14	0.515	0.847	No
Calcium	10/10	34,800	114,483	No
Chromium	14/14	80	20.62	**YES**
Cobalt	10/10	5.62	6.94	No
Copper	14/14	52	24.72	**YES**
Iron	14/14	21,000	22,731	No
Lead	14/14	240	18.23	**YES**
Magnesium	10/10	8,060	7,062	**YES**
Manganese	10/10	465	698	No
Mercury	1/14	0.0529	0.0572	No
Nickel	12/14	26.3	17.40	**YES**
Potassium	10/10	4,210	5,450	No
Silver	4/14	0.234	0.66	No

Table 5-134. Background Screening of Inorganic Chemicals Detected in Soil at SWMU 23 (continued)

Chemical	Frequency of Detection[a]	Maximum Detected Value (μg/g)	Site-specific Background Screening Value[b] (μg/g)	Exceeds Site-specific Background?
***Perimeter Area - Surface Soil* - (continued)**				
Sodium	10/10	350	337	**YES**
Vanadium	10/10	22.3	28.39	No
Zinc	14/14	300	102.8	**YES**
Perimeter Area - Subsurface Soil				
Aluminum	1/4	8,110	28,083	No
Arsenic	4/4	7.29	11.69	No
Barium	2/4	80.4	247	No
Calcium	4/4	36,100	114,483	No
Chromium	4/4	18.3	20.62	No
Cobalt	4/4	3.59	6.94	No
Copper	4/4	9.11	24.72	No
Iron	3/4	12,700	22,731	No
Lead	1/4	12.6	18.23	No
Magnesium	4/4	4,030	7,062	No
Manganese	2/4	275	698	No
Nickel	4/4	9.92	17.40	No
Potassium	1/4	1,410	5,450	No
Sodium	4/4	212	337	No
Vanadium	1/4	19.1	28.39	No

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]See Section 2.6.1.1 for an explanation of how the site-specific background screening values were calculated.

In subsurface soil, cadmium, chromium, lead, silver, and sodium were above background threshold values and were retained as preliminary COPCs. As with surface soil, all thallium analytical results had high CRLs, which exceeded the background values for this metal.

Building 1344 Outfall. At the Building 1344 Outfall, cadmium chromium, lead, and zinc were above background threshold values and were retained as preliminary COPCs in surface soil. In subsurface soil, chromium, mercury, and nickel were retained as preliminary COPCs. Thallium was not detected in surface or subsurface soil, but all thallium results had CRLs that exceeded the background screening value.

Building 1345 Outfall. In surface soil at the Building 1345 Outfall, barium, cadmium, chromium, cobalt, copper, cyanide, iron, lead, silver, sodium, and zinc were above background threshold values and were retained as preliminary COPCs. In subsurface soil, only chromium, lead, nickel, and sodium were retained as preliminary COPCs. Silver, which was not detected in subsurface soil, had CRLs that exceeded the background threshold values. Thallium was not detected in either surface or subsurface soil, but had CRLs that exceeded its background threshold value.

Asphalt Area and Stained Areas. In surface soil, chromium, copper, iron, lead, and mercury were above background threshold values and were retained as preliminary COPCs. Chromium, silver, and vanadium were retained as COPCs in subsurface soil. Thallium was not detected in either surface or subsurface soil, but had CRLs that exceeded its background threshold value.

Perimeter Area. Chromium, copper, lead, magnesium, nickel, sodium, and zinc were all retained as preliminary COPCs in surface soil because they exceeded background threshold values. No inorganic chemicals were retained as preliminary COPCs in subsurface soil based on background screening. Thallium was not detected in either surface or subsurface soil, but had CRLs that exceeded its background threshold value.

5.5.3.2 *Summary of Analytical Results*

The list of analytes detected in at least one surface or subsurface soil sample within each area of concern is provided in Table 5-135 for Phase I data and in Table 5-136 for Phase II data. The complete data set is contained in Appendix H.

5.5.3.3 *Nature and Extent of Contamination*

The following subsections describe the nature and extent of contaminants by specific areas of contamination.

Table 5-135. Summary of Analytes Detected for the Bomb and Shell Reconditioning Bldg. (SWMU 23) - Phase I

Building 1343 Outfall (Surface Soil)

Group	Analytes	Background Concentrations	BRS-92-08 (0ft)	BRS-92-09 (0ft)
METALS	BARIUM	247.1	120	160
	CHROMIUM	20.62	13	22*
	COPPER	24.72	66*	160*
	IRON	22731	13000	20000
	LEAD	18.23	29*	70*
	MERCURY	0.0572	0.0915*	0.199*
	SILVER	0.66	1.8*	0.115
	ZINC	102.8	240*	460*
ANIONS	NITRATE	N/A	5.11*	5.92*
	PHOSPHATE	N/A	64.5*	92.8*

Building 1344 Outfall (Surface Soil)

		Background Concentrations	BRS-92-07 (0ft)
METALS	BARIUM	247.1	40
	CADMIUM	0.847	1.82*
	CHROMIUM	20.62	43.6*
	COPPER	24.72	17.8
	IRON	22731	8200
	LEAD	18.23	100*
	NICKEL	17.4	3.65
	SILVER	0.66	0.0737
	ZINC	102.8	150*

Building 1345 Outfall (Surface Soil)

		Background Concentrations	BRS-92-01 (0ft)
METALS	BARIUM	247.1	260*
	CHROMIUM	20.62	90*
	COPPER	24.72	19.3
	IRON	22731	25000*
	LEAD	18.23	130*
	SILVER	0.66	0.179
	ZINC	102.8	2200*

Table 5-135. Summary of Analytes Detected in Soil for the Bomb and Shell Reconditioning Bldg. (SWMU 23) - Phase I (continued)

Asphalt Area (Surface Soil)

Group	Analytes	Background Concentrations	BRS-92-06 (0ft)
METALS	BARIUM	247.1	13.6
	CHROMIUM	20.82	18
	COPPER	24.72	77*
	IRON	22731	23000*
	LEAD	18.23	43*
	MERCURY	0.0572	0.174*
	SILVER	0.88	0.0816
	ZINC	102.8	76
SEMIVOLATILES	BENZO [A] ANTHRACENE	N/A	1.47*
	BENZO [A] PYRENE	N/A	1.26*
	BENZO [B] FLUORANTHENE	N/A	1.05*
	BENZO [G,H,I] PERYLENE	N/A	0.839*
	BENZO [K] FLUORANTHENE	N/A	1.26*
	CHRYSENE	N/A	1.47*
	FLUORANTHENE	N/A	1.68*
	INDENO [1,2,3-C,D] PYRENE	N/A	0.839*
	PHENANTHRENE	N/A	1.05*
	PYRENE	N/A	2.1*
ANIONS	CHLORIDE	N/A	56*
	NITRATE	N/A	28*

Perimeter Area (Surface Soil)

		Background Concentrations	BRS-92-02 (0ft)	BRS-92-03 (0ft)	BRS-92-04 (0ft)	BRS-92-05 (0ft)
METALS	BARIUM	247.1	74	31	110	78
	CADMIUM	0.847	0.515	LT 0.85	LT 0.424	LT 0.424
	CHROMIUM	20.82	80*	22*	70*	23.6*
	COPPER	24.72	27*	7.2	29*	52*
	IRON	22731	13000	6200	21000	16000
	LEAD	18.23	140*	40*	240*	110*
	NICKEL	17.4	LT 2.48	LT 4.9	24.3*	25.8*
	SILVER	0.66	0.234	0.0476	0.0982	0.0766
	ZINC	102.8	300*	40	140*	120*
ANIONS	NITRATE	N/A	LT 3.38	LT 3.38	6.59*	5.95*

Building 1343 Outfall (Surface Sediment)

		Background Concentrations	BRD-92-01 (0ft)
METALS	BARIUM	247.1	130
	CHROMIUM	20.82	17
	COPPER	24.72	170*
	IRON	22731	28000*
	LEAD	18.23	90*
	MERCURY	0.0572	0.145*
	NICKEL	17.4	8
	SILVER	0.66	0.0293
	ZINC	102.8	280*
SEMIVOLATILES	BUTYLBENZYL PHTHALATE	N/A	0.47*
	POLYCHLORINATED BIPHENYL 1254	N/A	0.646*
ANIONS	CHLORIDE	N/A	79.1*

Table 5-135. *Summary of Analytes Detected in Soil for the Bomb and Shell Reconditioning Bldg. (SWMU 23) - Phase I (continued)*

Building 1345 Outfall (Surface Sediment)

Group	Analytes	Background Concentrations	BRD-92-02 (0ft)
METALS	BARIUM	247.1	82
	CADMIUM	0.847	2.8*
	CHROMIUM	20.62	470*
	COPPER	24.72	99*
	IRON	22731	35000*
	LEAD	18.23	860*
	NICKEL	17.4	8.16
	SILVER	0.66	0.81*
	ZINC	102.8	1100*
SEMIVOLATILES	ACENEPHTHENE	N/A	0.427*
	BENZO [A] ANTHRACENE	N/A	0.854*
	BENZO [A] PYRENE	N/A	0.64*
	BENZO [B] FLUORANTHENE	N/A	0.64*
	BENZO [G,H,I] PERYLENE	N/A	0.427*
	BIS (2-ETHYHEXYL) PHTHALATE	N/A	2.13*
	CHRYSENE	N/A	1.07*
	FLUORANTHENE	N/A	1.28*
	INDENO [1,2,3-C,D] PYRENE	N/A	0.427*
	PHENANTHRENE	N/A	1.71*
	POLYCHLORINATED BIPHENYL 1248	N/A	4.8*
	PYRENE	N/A	2.13*
CYANIDE	CYANIDE	6	41.1*
PESTICIDES	POLYCHLORINATED BIPHENYL 1248	N/A	5.2*
ANIONS	NITRATE	N/A	7.27*

Surface Water

Group	Analytes	BRW-92-01 (0ft)	RW-92-01(F) (0ft)
METALS	BARIUM	79	NT
	COPPER	11.5	NT
	IRON	780	NT
	LEAD	12.1	NT
	ZINC	34.8	NT
ANIONS	BROMIDE	60.8*	NT
	CHLORIDE	110000*	NT
	NITRATE	1800*	NT
	PHOSPHATE	63.1*	43.4*
	SULFATE	52000*	NT
VOLATILES	ACETONE	14*	NT
	CHLOROMETHANE	6.76*	NT

Note.- All values in μg/g (equal to ppm) for soil and sediment and in μg/l (equal to ppb) for surface water.
N/A = Not Applicable.
NT = Not Tested.
* = Organic analyte detected above CRL or MDL or detected inorganic analyte exceeding background.
LT = Analyte concentration is less than CRL , the CRL is posted next to the "LT".
# = Analyte was detected in the associated blank in excess of the 5 or 10 times rule (as described in Section 3.1.1.1).
(F) = Filtered analytes.

Table 5-136. Summary of Analytes Detected in Soil for the Bomb and Shell Reconditioning Bldg. (SWMU 23) - Phase II

Building 1343 Outfall (Surface Soil)

Group	Analytes	Background Concentrations	BRB-94-12A (0.5ft)
METALS	ALUMINUM	28083	8090
	ARSENIC	11.69	5.9
	BARIUM	247.1	95.6
	CALCIUM	114483	69000
	CHROMIUM	20.62	23.1*
	COBALT	6.94	3.74
	COPPER	24.72	16.7
	IRON	22731	12200
	LEAD	18.23	24.3*
	MAGNESIUM	7061	4490
	MANGANESE	698.3	248
	NICKEL	17.4	8.42
	POTASSIUM	5449	2240
	SODIUM	337	332
	ZINC	102.8	48.1
SEMIVOLATILES	BENZYL ALCOHOL	N/A	0.06*
	DIMETHYL PHTHALATE	N/A	0.23*

Building 1344 Outfall (Surface Soil)

Group	Analytes	Background Concentrations	BRB-94-11A (0.5ft)
METALS	ALUMINUM	28083	5560
	ARSENIC	11.69	5.65
	BARIUM	247.1	57.2
	CADMIUM	0.847	2.66*
	CALCIUM	114483	19100
	CHROMIUM	20.62	39.2*
	COBALT	6.94	3.46
	COPPER	24.72	18.1
	IRON	22731	9860
	LEAD	18.23	115*
	MAGNESIUM	7061	3120
	MANGANESE	698.3	169
	NICKEL	17.4	7.64
	POTASSIUM	5449	1270
	SODIUM	337	143
	VANADIUM	28.39	12.8
	ZINC	102.8	90
SEMIVOLATILES	ACENEPHTHENE	N/A	0.33*
	BENZO [A] ANTHRACENE	N/A	2.8*
	BENZO [B] FLUORANTHENE	N/A	3.8*
	BENZO [G,H,I] PERYLENE	N/A	2.2*
	BENZO [K] FLUORANTHENE	N/A	1.4*
	CHRYSENE	N/A	3.1*
	FLUORANTHENE	N/A	2.9*
	FLUORENE	N/A	0.18*
	PHENANTHRENE	N/A	2.4*
	PYRENE	N/A	4.1*
PESTICIDES/PCBS	POLYCHLORINATED BIPHENYL 1254	N/A	0.0981*

Table 5-136. Summary of Analytes Detected in Soil for the Bomb and Shell Reconditioning Bldg. (SWMU 23) - Phase II (continued)

Building 1345 Outfall (Surface Soil)

Group	Analytes	Background Concentrations	BRB-94-10A (0.5ft)	BRP-94-06A (0.5ft)	BRP-94-07A (0.5ft)	BRP-94-08A (0.5ft)	BRP-94-09A (0.5ft)	BRP-94-09A(D) (0.5ft)	BRB-94-06 (0.5ft)
METALS	ALUMINUM	28083	8820	9600	11100	4120#	5750#	5440	9850
	ARSENIC	11.69	4.19	6.14	6.11	3.93	3.11	3.27	6.98
	BARIUM	247.1	84.5	119	91.3	57.3	126	126	119
	CADMIUM	0.847	5.08*	4.85*	LT 1.2	16.9*	46*	52.4*	LT 1.2
	CALCIUM	114483	7680	39100	19800	12500	21900	27300	8320
	CHROMIUM	20.62	39*	36.8*	36*	79.4*	163*	160*	9.83
	COBALT	6.94	4.38	4.49	5.08	3.49	10.2*	10.5*	4.84
	COPPER	24.72	14.3	25.5*	14.8	18.8	58.6*	73.4*	9.73
	IRON	22731	11900	17200	13300	8840	16900	20500	12000
	LEAD	18.23	79.1*	99.3*	51.6*	252*	469*	292*	9.84
	MAGNESIUM	7061	3750	6580	4360	3710	3850	4010	8470
	MANGANESE	698.3	125#	292	227	130#	174	198	396
	NICKEL	17.4	7.51	17.5#	7.3	5.43	12.4	16	5.76
	POTASSIUM	5449	2100	2830	2690	1020#	1300	1270	3080
	SODIUM	337	227	208	293	157	237	226	352*
	VANADIUM	28.39	15.2	16.8	23.1	12.1	12.9#	13.7	14.3
	ZINC	102.8	727*	81.4	92.2	160*	1010*	1050*	39.1
SEMIVOLATILES	2-METHYLNAPHTHALENE	N/A	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032	0.056*	0.49*
	ACENAPHTHYLENE	N/A	LT 0.033	LT 0.033	LT 0.033	LT 0.033	LT 0.033	LT 0.033	0.085*
	ACENEPHTHENE	N/A	0.55*	LT 0.041	0.12*	LT 0.041	LT 0.041	LT 0.041	3.4*
	ANTHRACENE	N/A	LT 0.71	LT 0.71	LT 0.71	LT 0.71	LT 0.71	LT 0.71	3.6*
	BENZO [A] ANTHRACENE	N/A	1*	0.44*	0.25*	0.17*	0.28*	0.35*	5.3*
	BENZO [A] PYRENE	N/A	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	4.7*
	BENZO [B] FLUORANTHENE	N/A	1.2*	0.7*	LT 0.31	LT 0.31	LT 0.31	0.73*	5.6*
	BENZO [G,H,I] PERYLENE	N/A	0.66*	0.38*	LT 0.18	LT 0.18	LT 0.18	0.37*	2.3*
	BENZO [K] FLUORANTHENE	N/A	0.59*	0.27*	LT 0.13	LT 0.13	LT 0.13	0.33*	2.3*
	BENZYL ALCOHOL	N/A	LT 0.032	0.083*	0.068*	0.07*	LT 0.032	LT 0.032	LT 0.032
	BIS (2-ETHYHEXYL) PHTHALATE	N/A	LT 0.48	1.3*	1.1*	3.4*	3.7*	7.2*	LT 0.48
	CHRYSENE	N/A	1.2*	0.85*	0.35*	0.28*	0.39*	0.62*	6.4*
	DI-N-BUTYL PHTHALATE	N/A	LT 1.3	LT 1.3	LT 1.3	1.9*	LT 1.3	1.5*	LT 1.3
	DIBENZ [AH] ANTHRACENE	N/A.	LT 0.31	LT 0.31	LT 0.31	LT 0.31	LT 0.31	LT 0.31	0.58*
	DIBENZOFURAN	N/A	LT 0.38	LT 0.38	LT 0.38	LT 0.38	LT 0.38	LT 0.38	0.65*
	DIETHYL PHTHALATE	N/A	LT 0.24	LT 0.24	LT 0.24	LT 0.24	LT 0.24	LT 0.24	0.53*
	DIMETHYL PHTHALATE	N/A	0.46*	0.13*	LT 0.063	0.14*	0.32*	0.11*	LT 0.063
	FLUORANTHENE	N/A	1.5*	0.4*	0.32*	0.18*	0.22*	0.34*	5.5*
	FLUORENE	N/A	0.29*	LT 0.066	LT 0.066	LT 0.066	LT 0.066	LT 0.066	2*
	PHENANTHRENE	N/A	2.3*	0.36*	0.42*	0.18*	0.18*	0.3*	9.5*
	PYRENE	N/A	2*	0.94*	0.56*	0.41*	0.42*	0.84*	10*
CYANIDE	CYANIDE	5	1.12	LT 0.25	LT 0.25	1.71	13*	13*	LT 0.25
PESTICIDES/PCBS	POLYCHLORINATED BIPHENYL 1248	N/A	ND 0.1	NT	NT	0.925*	28*	34*	NT
	POLYCHLORINATED BIPHENYL 1254	N/A	0.235*	NT	NT	ND 0.0479	ND 0.48	ND 0.48	NT

Table 5-136. *Summary of Analytes Detected in Soil for the Bomb and Shell Reconditioning Bldg. (SWMU 23) - Phase II (continued)*

Asphalt Area (Surface Soil)

Group	Analytes	Background Concentrations	BRB-94-02A (0.6ft)	BRB-94-04A (0.6ft)	BRB-94-05A (0.6ft)	BRP-94-13A (0.6ft)	BRB-94-01 (0.6ft)
METALS	ALUMINUM	28083	7900	7470	8630	7360	3700
	ARSENIC	11.89	3.96	4.07	5.94	3.29	4.28
	BARIUM	247.1	79.7	70.4	70.4	68.4	49.4
	CALCIUM	114483	46300	29200	23200	30800	29400
	CHROMIUM	20.62	70.5*	28*	162*	8.9	11
	COBALT	8.94	3.49	LT 2.6	3.58	3.76	3.17
	COPPER	24.72	8.12	14.3	10.7	7.2	13.9
	IRON	22731	11100	9010	19000	9380	6940
	LEAD	18.23	10.3	LT 7.44	LT 7.44	10.6	27.6*
	MAGNESIUM	7081	5930	4900	4640	4470	3320
	MANGANESE	698.3	227	171	186	176	142
	NICKEL	17.4	7.47	14#	18.8#	6.67	3
	POTASSIUM	5449	2070	1960	1770	1700	672#
	SODIUM	337	336	256	176	243	213
	VANADIUM	28.39	13.9#	14.2#	12.1#	12.9#	8.14
	ZINC	102.8	28.6#	23.7	22.7	26.5#	26.9
SEMIVOLATILES	2-METHYLNAPHTHALENE	N/A	LT 0.032	0.05*	LT 0.032	LT 0.032	LT 0.032
	ACENEPHTHENE	N/A	LT 0.041	LT 0.041	0.11*	LT 0.041	0.36*
	BENZO [A] ANTHRACENE	N/A	LT 0.041	0.21*	0.42*	LT 0.041	1.4*
	BENZO [B] FLUORANTHENE	N/A	LT 0.31	LT 0.31	LT 0.31	LT 0.31	1.9*
	BENZO [G,H,I] PERYLENE	N/A	LT 0.18	LT 0.18	LT 0.18	LT 0.18	0.97*
	BENZO [K] FLUORANTHENE	N/A	LT 0.13	LT 0.13	LT 0.13	LT 0.13	0.86*
	BENZYL ALCOHOL	N/A	LT 0.032	0.07*	LT 0.032	LT 0.032	0.045*
	CHRYSENE	N/A	0.15*	0.46*	0.67*	LT 0.032	2.1*
	FLUORANTHENE	N/A	0.061*	0.08*	0.45*	LT 0.032	1.7*
	FLUORENE	N/A	LT 0.066	LT 0.066	LT 0.066	LT 0.066	0.2*
	PHENANTHRENE	N/A	0.11*	0.21*	0.57*	LT 0.032	1.8*
	PYRENE	N/A	0.22*	0.6*	0.92*	LT 0.083	3*

Perimeter Area (Surface Soil)

Group	Analytes	Background Concentrations	BRP-94-01A (0.5ft)	BRP-94-03A (0.5ft)	BRS-94-02 (0.5ft)	BRS-94-03 (0.5ft)	BRS-94-04 (0.5ft)	BRS-94-05 (0.5ft)	BRS-94-07 (0.5ft)	BRS-94-08 (0.5ft)	BRS-94-09 (0.5ft)	BRS-94-10 (0.5ft)
METALS	ALUMINUM	28083	13200	13600	11900	8630	11300	5460	8230	13100	6190	7860
	ARSENIC	11.89	4.58	6.26	6.56	4.36	4.62	6.3	6.08	7.17	6.9	2.92
	BARIUM	247.1	118	101	120	80.1	113	63.6	84.8	143	74.3	96.2
	BERYLLIUM	1.466	0.573	0.57	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427
	CALCIUM	114483	22400	3300	4470	34800	3640	33000	25200	14400	19800	18700
	CHROMIUM	20.62	23.3*	18.9	12	10.2	12.4	7.3	19.2	16.1	8.67	10.6
	COBALT	8.94	6.16	6.26	6.6	3.61	6.28	3.4	4.46	6.62	2.98	3.93
	COPPER	24.72	20.6	11.6	11.9	9.86	10.6	9.96	11.6	14.4	24.9*	20.4
	IRON	22731	15300	14600	13800	9700	13200	7940	11800	15600	9030	11100
	LEAD	18.23	34*	14.8	14.6	16	13.3	14	30.1*	13.1	12.6	13.2
	MAGNESIUM	7081	7260*	3990	6480	6080	6080	4560	4310	8660*	4060	4880
	MANGANESE	698.3	376	313	372	239	361	181	239	486	144	229
	MERCURY	0.0672	0.073#	0.0688#	LT 0.06	LT 0.06	LT 0.06	LT 0.06	LT 0.06	LT 0.06	0.0629	LT 0.06
	NICKEL	17.4	8.64	7.94	7.66	4.76	6.76	3.14	5.66	8.81	3.56	4.86
	POTASSIUM	5449	3680	3410	3210	1670	3060	1290	1840	4210	1380	2160
	SODIUM	337	300	226	228	244	229	311	194	264	303	350*
	VANADIUM	28.39	21	22.3	16.5	12.3	14.8	8.71	16.3	19.9	9.04	13.3
	ZINC	102.8	61.9	43.6	41.7	30.3	42.8	29.1	48.2	50.2	76.4	88
SEMIVOLATILES	BENZYL ALCOHOL	N/A	LT 0.032	0.053*	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032
	FLUORANTHENE	N/A	LT 0.032	LT 0.032	LT 0.032	LT 0.032	0.045*	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032
	PHENANTHRENE	N/A	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032	0.18*	0.15*

Table 5-136. Summary of Analytes Detected in Soil for the Bomb and Shell Reconditioning Bldg. (SWMU 23) - Phase II (continued)

Building 1345 Outfall (Subsurface Soil)

Group	Analytes	Background Concentrations	BRB-94-10B (3ft)	BRB-94-10C (5ft)	BRB-94-15A (3ft)	BRB-94-15B (5ft)	BRP-94-06B (3ft)	BRP-94-06C (5ft)	BRP-94-07B (3ft)	BRP-94-07C (5ft)	BRP-94-08B (3ft)	BRP-94-08C (5ft)
METALS	ALUMINUM	28083	3330#	1870#	4100#	2820#	8470	2080#	2980#	2400#	2400#	3560#
	ARSENIC	11.69	5.91	3.32	4.57	3.01	8.21	5.23	4.98	2.98	3.71	2.88
	BARIUM	247.1	32.9#	34.3#	46.3	25.6#	64.8	30.8#	32#	28.7#	30.2#	25.1#
	CALCIUM	114483	20800	36600	18200	27800	8430	22600	21800	20100	17900	20000
	CHROMIUM	20.62	58.1*	66.6*	47.1*	20.7*	8.89	3.81	7.39#	6.8#	8.61	8.5
	COBALT	6.94	3.18	3.49	LT 2.5	LT 2.5	3.26	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5
	COPPER	24.72	10.1	16.2	5.11	4.27	13.7	5.23	6.02	3.98	4.45	5.2
	IRON	22731	11400	12700	9600	8700	12000	5840#	8780	4960#	4350#	8260
	LEAD	18.23	9.84	LT 7.44	9.65	LT 7.44	LT 7.44	LT 7.44	8.9	LT 7.44	9.78	LT 7.44
	MAGNESIUM	7061	3930	2830	1930	2460	2310	2380	2160	1380	1180	2420
	MANGANESE	698.3	136#	140#	143#	71.9#	168	101#	121#	75.9#	91.3#	61#
	MERCURY	0.0672	0.0561	LT 0.05	LT 0.06	LT 0.05	0.0629#	0.0734#	0.0639#	0.0853#	0.106#	0.0888#
	NICKEL	17.4	9.73	30*	6.72	4.88	14.5#	9.85#	3.87	3.99	3.82	5.91
	POTASSIUM	6449	627#	398#	717#	467#	1460	319#	493#	396#	493#	450#
	SODIUM	337	177	128	259	219	169	121	109	173	117	396*
	VANADIUM	28.39	20	16.5	14.8	11.9	16	6.8#	10.9#	7.19#	6.42#	11.2
	ZINC	102.8	43.4	19.8	26.8	22.9	19.3	9.09#	18.7#	16.7#	25.3	14.3#
SEMIVOLATILES	BENZYL ALCOHOL	N/A	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032	0.065*	LT 0.032
PESTICIDES/PCBS	POLYCHLORINATED BIPHENYL 1248	N/A	ND 0.1	ND 0.1	ND 0.1	ND 0.1	NT	NT	NT	NT	ND 0.1	ND 0.1

Group	Analytes	Background Concentrations	BRP-94-09B (3ft)	BRP-94-09B(D) (3ft)	BRP-94-09C (5ft)	BRP-94-09C(D) (5ft)
METALS	ALUMINUM	28083	4700#	3830#	4090#	3380#
	ARSENIC	11.69	7.03	6.67	4.84	4.6
	BARIUM	247.1	45.1#	41.4#	41.2#	38.1#
	CALCIUM	114483	20800	19100	18600	24200
	CHROMIUM	20.62	13.9	12.7	12.1	10.7
	COBALT	6.94	LT 2.5	LT 2.5	LT 2.5	LT 2.5
	COPPER	24.72	8.53	6.6	5.61	5.31
	IRON	22731	8300#	6380	7200	6660
	LEAD	18.23	18	21.8*	10.3	13
	MAGNESIUM	7061	2290	2120	1440	1420
	MANGANESE	698.3	128#	109#	112#	112#
	MERCURY	0.0672	0.0707#	0.084#	0.0762#	0.0728#
	NICKEL	17.4	3.87	5.35	6.23	5.52
	POTASSIUM	6449	801#	767#	650#	518#
	SODIUM	337	318	157	172	157
	VANADIUM	28.39	11.1#	8.92#	11.2	9.74#
	ZINC	102.8	41.3	46.4	22.1	20
SEMIVOLATILES	BENZYL ALCOHOL	N/A	LT 0.032	LT 0.032	0.065*	0.083*
PESTICIDES/PCBS	POLYCHLORINATED BIPHENYL 1248	N/A	0.117*	0.184*	ND 0.1	ND 0.1

Table 5-136. Summary of Analytes Detected in Soil for the Bomb and Shell Reconditioning Bldg. (SWMU 23) - Phase II (continued)

Building 1343 Outfall (Subsurface Soil)

Group	Analytes	Background Concentrations	BRB-94-12B (3ft)	BRB-94-12C (5ft)	BRB-94-16A (3ft)	BRB-94-16B (5ft)	BRB-94-17A (3ft)	BRB-94-17B (5ft)
METALS	ALUMINUM	28083	8100	4990#	4880	3180#	2730#	2610#
	ARSENIC	11.89	5.34	3.67	3.83	4.26	3.44	3.58
	BARIUM	247.1	78.2	39.6#	50.4	50.8	38.5#	31.8#
	CADMIUM	0.847	2.24*	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2
	CALCIUM	114483	28800	13000	13100	38800	22800	24100
	CHROMIUM	20.82	54.6*	14.3	14.7	23.8*	36.7*	16.1
	COBALT	6.94	6.83	3.4	4.14	3.09	4.67	2.93
	COPPER	24.72	20.6	6.41	9.79	5.38	9.38	6.89
	IRON	22731	13800	7820#	7790	6820	6790	6580
	LEAD	18.23	31*	LT 7.44	8.04	8.06	LT 7.44	LT 7.44
	MAGNESIUM	7081	4730	1540	2140	3370	1810	2760
	MANGANESE	698.3	224	107#	117#	99.5#	95.5#	84.4#
	MERCURY	0.0572	0.0783#	0.084#	0.0536	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	9.86	3.9	7.74	5.74	7.65	5.71
	POTASSIUM	5449	2060	846#	1170	802#	659#	555#
	SILVER	0.86	5.85*	LT 0.803	0.975*	LT 0.803	1.24*	LT 0.803
	SODIUM	337	445*	283	241	225	186	278
	VANADIUM	28.39	23.8	15#	18.9	16.9	19.7	22.1
	ZINC	102.8	44.9	16.5#	24.7	14.8#	20.1	13.4#
SEMIVOLATILES	BENZO [A] ANTHRACENE	N/A	LT 0.041	LT 0.041	LT 0.041	LT 0.041	0.14*	LT 0.041
	BIS (2-ETHYHEXYL) PHTHALATE	N/A	0.9*	LT 0.48	LT 0.48	LT 0.48	LT 0.48	LT 0.48
	CHRYSENE	N/A	LT 0.032	LT 0.032	LT 0.032	LT 0.032	0.11*	LT 0.032
	FLUORANTHENE	N/A	LT 0.032	LT 0.032	LT 0.032	LT 0.032	0.16*	0.054*

Building 1344 Outfall (Subsurface Soil)

Group	Analytes	Background Concentrations	BRB-94-11B (3ft)	BRB-94-11C (5ft)	BRB-94-14A (3ft)	BRB-94-14B (5ft)
METALS	ARSENIC	11.89	5.81	4.99	4.16	4.25
	CALCIUM	114483	16300	29100	39600	48500
	CHROMIUM	20.82	537*	36.3*	127*	42.4*
	COBALT	6.94	3.81	LT 2.5	LT 2.5	LT 2.5
	COPPER	24.72	11.8	5.98	5.51	4.94
	IRON	22731	11700	6160	7240	5520#
	LEAD	18.23	13.6	12.3	8.67	LT 7.44
	MAGNESIUM	7081	1280	2430	2780	1710
	MERCURY	0.0572	LT 0.05	0.0596*	LT 0.05	LT 0.05
	NICKEL	17.4	19.8*	5.9	12.4	6.13
	SODIUM	337	154	156	240	249
	VANADIUM	28.39	18.2	11.7	9.63#	21.2
	ZINC	102.8	19.6	17.4#	16.3#	14.2#
SEMIVOLATILES	ACENEPHTHENE	N/A	LT 0.041	0.12*	LT 0.041	LT 0.041
	BENZO [A] ANTHRACENE	N/A	0.21*	0.45*	LT 0.041	LT 0.041
	BENZO [B] FLUORANTHENE	N/A	LT 0.31	0.6*	LT 0.31	LT 0.31
	BENZO [K] FLUORANTHENE	N/A	LT 0.13	0.3*	LT 0.13	LT 0.13
	CHRYSENE	N/A	0.23*	0.49*	LT 0.032	LT 0.032
	FLUORANTHENE	N/A	0.2*	0.51*	LT 0.032	LT 0.032
	PHENANTHRENE	N/A	0.18*	0.61*	LT 0.032	LT 0.032
	PYRENE	N/A	0.29*	0.62*	LT 0.083	LT 0.083

Table 5-136. Summary of Analytes Detected in Soil for the Bomb and Shell Reconditioning Bldg. (SWMU 23) - Phase II (continued)

Asphalt Area (Subsurface Soil)

Group	Analytes	Background Concentrations	BRB-94-02B (3ft)	BRB-94-02C (6ft)	BRB-94-04B (3ft)	BRB-94-04C (6ft)	BRB-94-05B (3ft)	BRB-94-05C (6ft)	BRP-94-13B (3ft)	BRP-94-13C (6ft)
METALS	ALUMINUM	28083	2680#	1410#	7290	2880#	4930#	2290#	2010#	1630#
	ARSENIC	11.69	LT 2.6	4.98	3.27	3.31	7.22	2.68	6.26	LT 2.6
	BARIUM	247.1	30.9#	16.9#	68.7	38.3#	50.6#	24.8#	21.2#	14.8#
	CALCIUM	114483	32900	64000	95000	28600	25900	46100	36000	42300
	CHROMIUM	20.62	78.2*	27.6*	27.4*	14.5	116*	16.6	4.07#	3.76#
	COBALT	6.94	3.38	LT 2.6	LT 2.6	LT 2.6	6.41	4.69	LT 2.6	2.66
	COPPER	24.72	8.72	4.03	14	6.24	7.16	4.19	3.94	LT 2.84
	IRON	22731	6410#	7010#	8800	5930#	11300	4460#	4710#	3770#
	LEAD	18.23	LT 7.44	14	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	8.12
	MAGNESIUM	7061	3700	3670	4790	3230	4080	2640	2640	3030
	MANGANESE	698.3	74.9#	73.9#	187	88.4#	136#	79.7#	69.2#	54.2#
	NICKEL	17.4	7.34	4.78	13.7#	11.8#	17.2#	10.8#	3.73	LT 2.74
	POTASSIUM	5449	667#	257#	1910	701#	1040#	643#	322#	201#
	SILVER	0.66	1.39*	LT 0.803	LT 0.803	LT 0.803	LT 0.803	LT 0.803	LT 0.803	LT 0.803
	SODIUM	337	222	108	260	227	134	100	163	262
	VANADIUM	28.39	22.9	9.03#	13.9#	10.4#	16.9	47.2*	6.44#	4.66#
	ZINC	102.8	12.2#	12.7#	23.1	11.2#	16	6.28#	11#	11.1#
SEMIVOLATILES	2-METHYLNAPHTHALENE	N/A	0.22*	LT 0.032	0.082*	0.25*	LT 0.032	LT 0.032	LT 0.032	LT 0.032
	BENZO (A) ANTHRACENE	N/A	0.85*	LT 0.041	0.35*	1.5*	0.14*	LT 0.041	LT 0.041	LT 0.041
	BENZO (B) FLUORANTHENE	N/A	LT 0.31	LT 0.31	LT 0.31	0.65*	LT 0.31	LT 0.31	LT 0.31	LT 0.31
	BENZO (G,H,I) PERYLENE	N/A	0.49*	LT 0.18	LT 0.18	0.94*	LT 0.18	LT 0.18	LT 0.18	LT 0.18
	BENZYL ALCOHOL	N/A	0.06*	0.067*	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032	LT 0.032
	CHRYSENE	N/A	1.6*	LT 0.032	0.88*	2.5*	0.27*	LT 0.032	LT 0.032	LT 0.032
	FLUORANTHENE	N/A	0.14*	LT 0.032	0.064*	0.2*	0.051*	LT 0.032	LT 0.032	LT 0.032
	PHENANTHRENE	N/A	0.69*	LT 0.032	0.38*	1.2*	0.14*	LT 0.032	LT 0.032	LT 0.032
	PYRENE	N/A	2.4*	LT 0.083	1.3*	4.3*	0.42*	LT 0.083	LT 0.083	LT 0.083

Perimeter Area (Subsurface Soil)

Group	Analytes	Background Concentrations	BRP-94-01B (3ft)	BRP-94-01C (6ft)	BRP-94-03B (3ft)	BRP-94-03C (6ft)
METALS	ALUMINUM	28083	4700#	8110	5760#	3840#
	ARSENIC	11.69	4.7	7.29	7.22	4.67
	BARIUM	247.1	39.1#	80.4	55.6	n
	CALCIUM	114483	13900	36100	23700	24600
	CHROMIUM	20.62	9.09	12.2	18.3	18.1
	COBALT	6.94	3.19	3.59	3.29	3.18
	COPPER	24.72	6.83	9.11	5.64	5.34
	IRON	22731	8930	12700	10200	7380#
	LEAD	18.23	LT 7.44	12.6	LT 7.44	LT 7.44
	MAGNESIUM	7061	1490	4030	2070	2180
	MANGANESE	698.3	105#	275	179	130#
	NICKEL	17.4	5.53	9.92	6.76	4.46
	POTASSIUM	5449	678#	1410	913#	647#
	SODIUM	337	127	212	169	139
	VANADIUM	28.39	16.3#	19.1	15.8#	11.9#
SEMIVOLATILES	BENZYL ALCOHOL	N/A	0.066*	0.046*	LT 0.032	LT 0.032

Note.- All values in $\mu g/g$ (equal to ppm).
ND = Analyte not detected above the MDL, the MDL is posted next to the "ND".
N/A = Not Applicable.
* = Organic analyte detected above CRL or MDL or detected inorganic analyte exceeding background.
# = Analyte was detected in the associated blank in excess of the 5 or 10 times rule (as described in Section 3.1.1.1).
LT = Analyte concentration is less than CRL, the CRL is posted next to the "LT".
(D) = Duplicate analysis.
NT = Not Tested.

5.5.3.3.1 ***Building 1343 Outfall.*** Sediment sample BRD-92-01, collected during Phase I at the discharge point of the outfall pipe, contained elevated concentrations of copper, iron, mercury, lead, and zinc (see Figure 5-14). Soil boring BRB-94-12, drilled in the drainage ditch just below the outfall discharge point, showed elevated concentrations of chromium (23.1 $\mu g/g$) and lead (24.3 $\mu g/g$) in the surface sample, and elevated concentrations of silver (5.05 $\mu g/g$), cadmium (2.24 $\mu g/g$), chromium (54.6 $\mu g/g$), lead (31 $\mu g/g$), and sodium (445 $\mu g/g$) at 3 feet. No metals were elevated at a depth of 5 feet (Figure 5-16). On the other side of the culvert and the road, samples BRS-92-08 and -09 had elevated concentrations of mercury (0.0915 and 0.0199 $\mu g/g$), copper (66 and 160 $\mu g/g$), zinc (240 and 460 $\mu g/g$), and lead (29 and 70 $\mu g/g$, respectively). Silver was also above background in BRS-92-08 (1.8 $\mu g/g$), and chromium was elevated in BRS-92-09 (22 $\mu g/g$). Soil borings BRB-94-16 and BRB-94-17 had elevated levels of silver (0.975 and 1.24 $\mu g/g$, respectively) and chromium (ranging from 23.8 to 36.7 $\mu g/g$) in subsurface soils. Low levels of PAHs and other SVOCs were detected in both surface and subsurface soils in the area of the outfall and discharge area (see Figures 5-14, 5-17, and 5-18).

PCB-1254 was detected at a concentration of 0.646 $\mu g/g$ in a sediment sample (BRD-92-01) collected during Phase I at the discharge point of the outfall pipe (Figure 5-14). No PCBs were detected in samples collected from soil boring BRB-94-12, also located near the outfall discharge point (Figure 5-19).

5.5.3.3.2 ***Outfall Area Near Building 1344.*** The outfall area near Building 1344 drains surface water from the asphalt parking area located between Buildings 1345 and 1343 as well as the drainage ditch from the Building 1343 outfall discharge pipe. Phase I surface soil sample BRS-92-07, collected from the outfall area (Figure 5-14), had elevated concentrations of cadmium (1.82 $\mu g/g$), chromium (43.6 $\mu g/g$), lead (100 $\mu g/g$), and zinc (150 $\mu g/g$). During Phase II, soil borings BRB-94-11 and -14 were drilled in the outfall area. Chromium (39.2 $\mu g/g$), cadmium (2.66 $\mu g/g$), and lead (115 $\mu g/g$) in surface soil, and chromium (ranging from 36.3 to 537 $\mu g/g$), mercury (0.0596 $\mu g/g$), and nickel (19.8 $\mu g/g$) in the subsurface soil were detected in concentrations elevated above background. The highest detection of chromium in soil at the Bomb Shell Reconditioning Site (SWMU 23) was detected at 537 $\mu g/g$ in the 3-foot sample interval from soil boring BRB-94-11; however, the concentration decreased to 36.3 $\mu g/g$ at the 5-foot interval. The horizontal extent of elevated metals is limited to the outfall area on both sides of the culvert and in the area of surface water ponding northeast of the culvert. Metals contamination is primarily limited to surface soil with concentrations decreasing with depth (Figure 5-16).

PCB Aroclor 1254 was detected at a concentration of 0.0981 $\mu g/g$ in the surface soil from boring BRB-94-11, located across the road from the outfall area near Building 1344. This was the only sample collected in this area that showed PCB concentrations at detectable levels (see Figure 5-19). Several carcinogenic and noncarcinogenic PAHs were also detected in surface and subsurface samples collected from BRB-94-11 (see Figures 5-17 and 5-18).

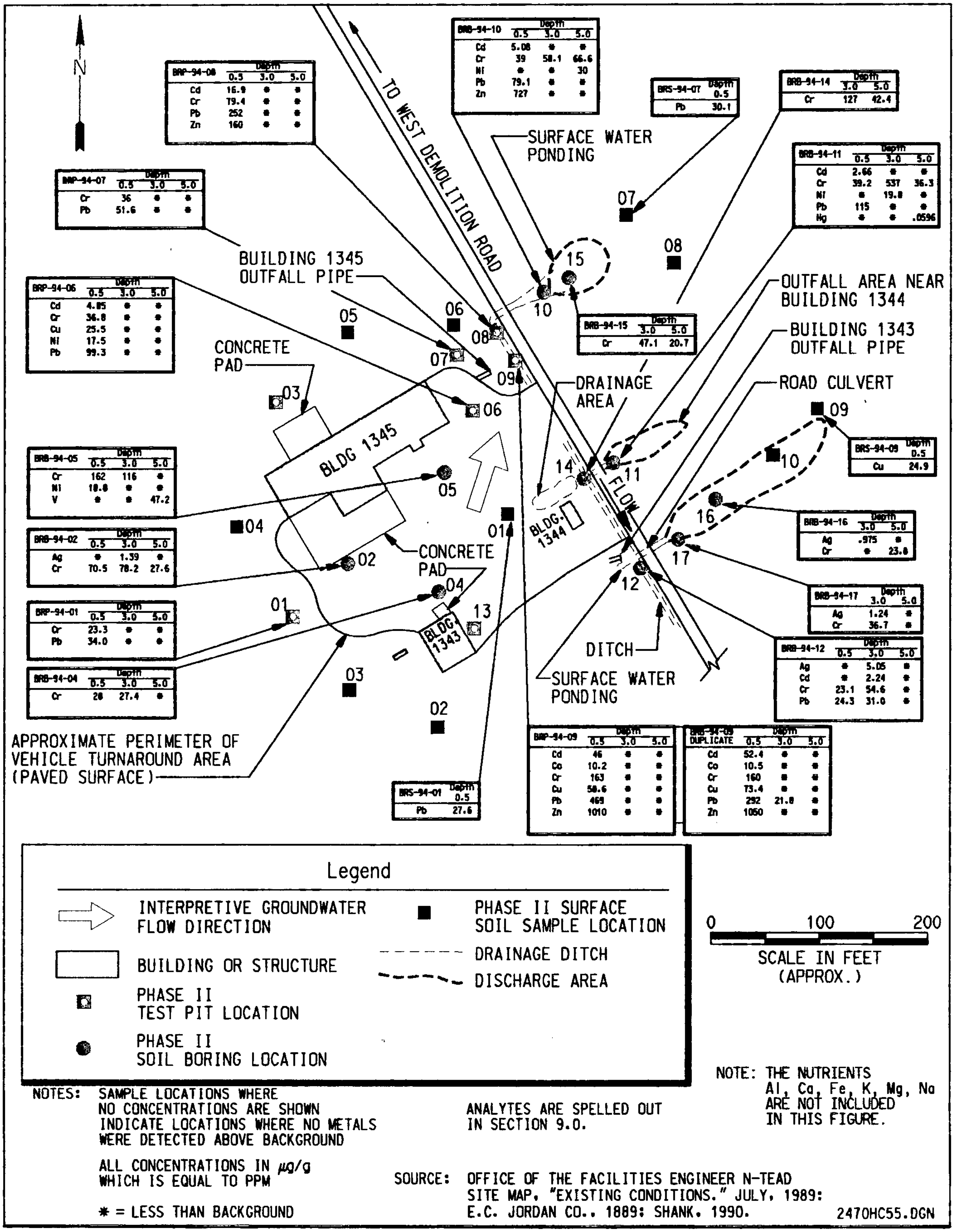

Figure 5-16. SWMU 23 Phase II Metals Results

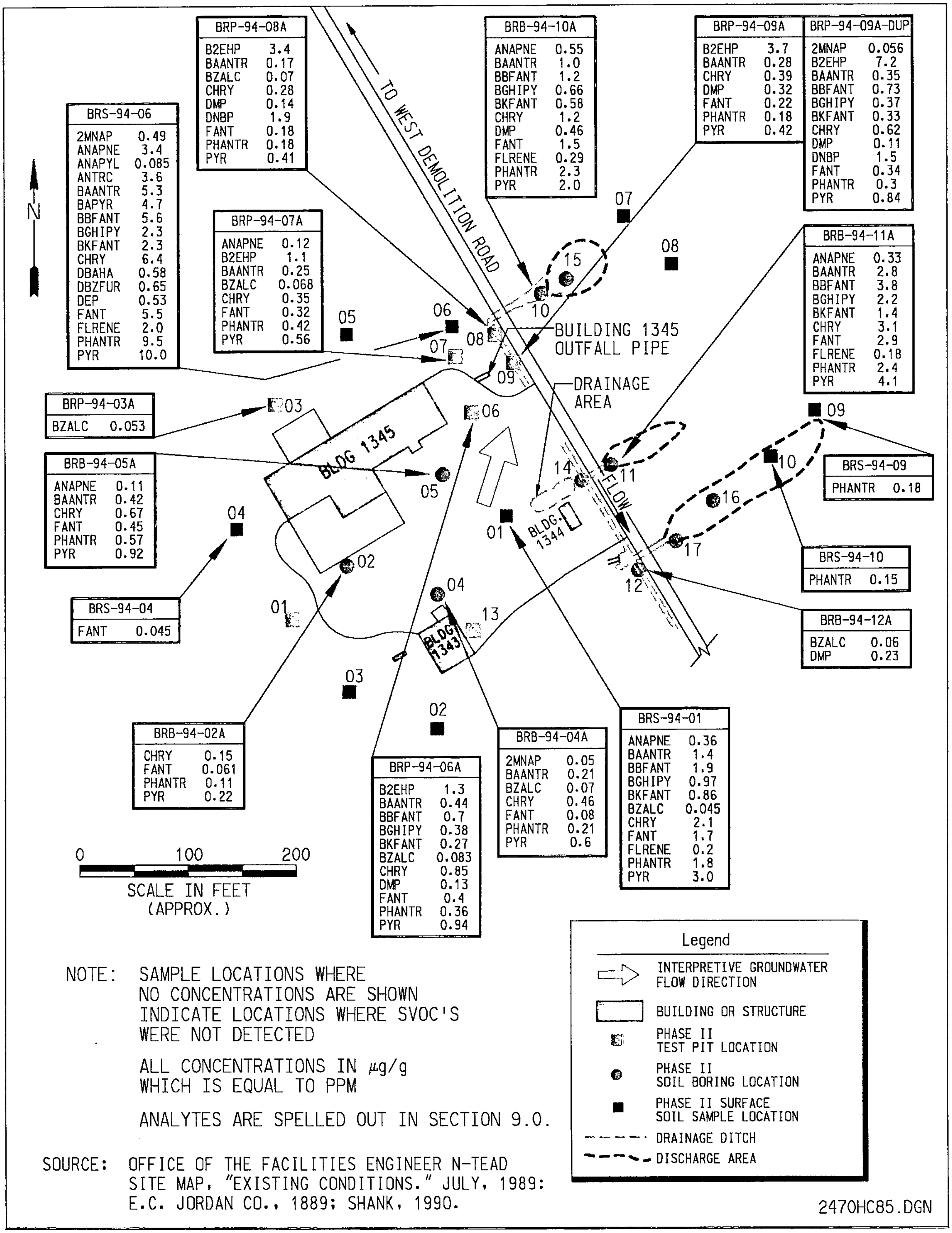

Figure 5-17. SWMU 23 Phase II Surface Soil SVOC Results

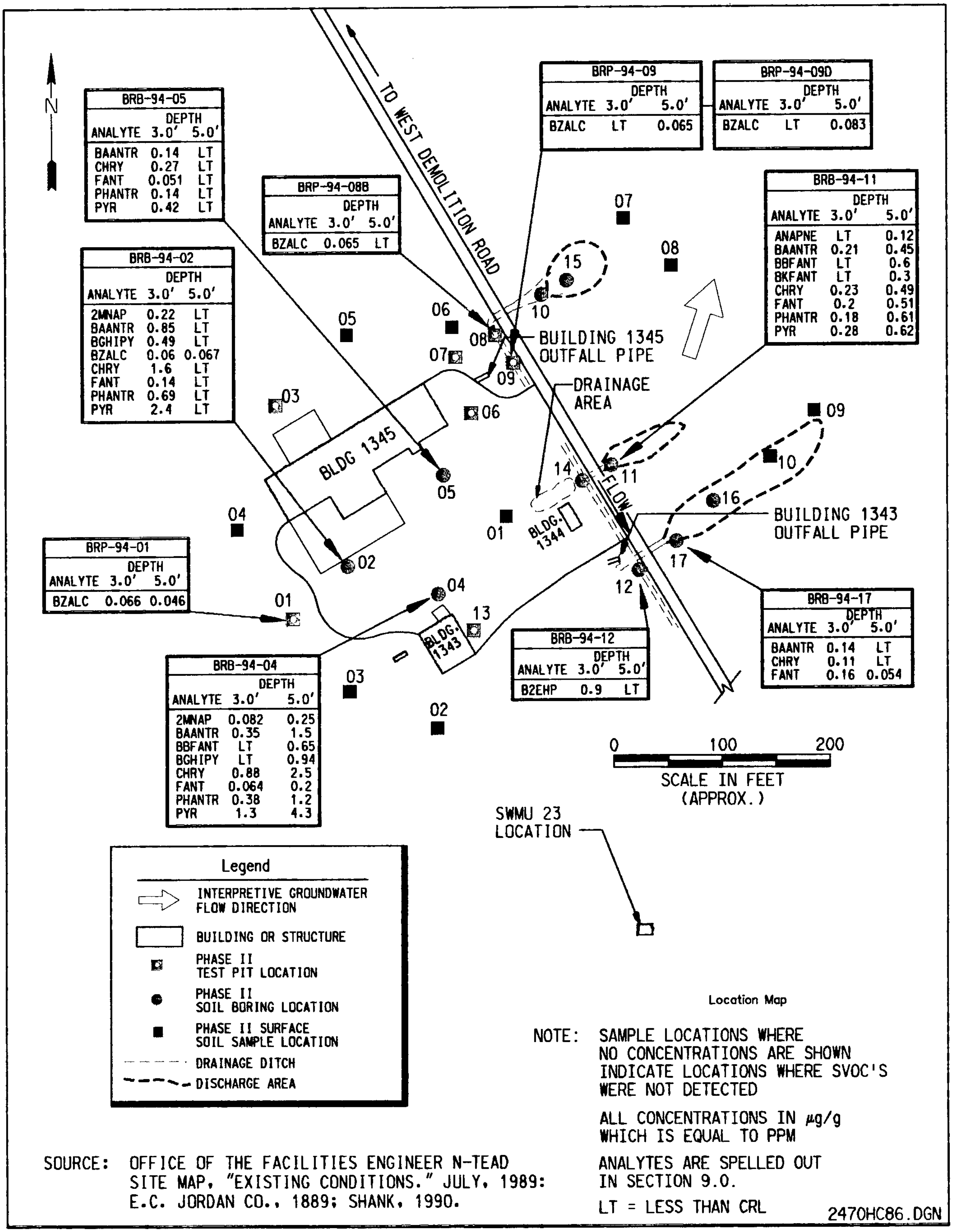

Figure 5-18. SWMU 23 Phase II Subsurface Soil SVOC Results

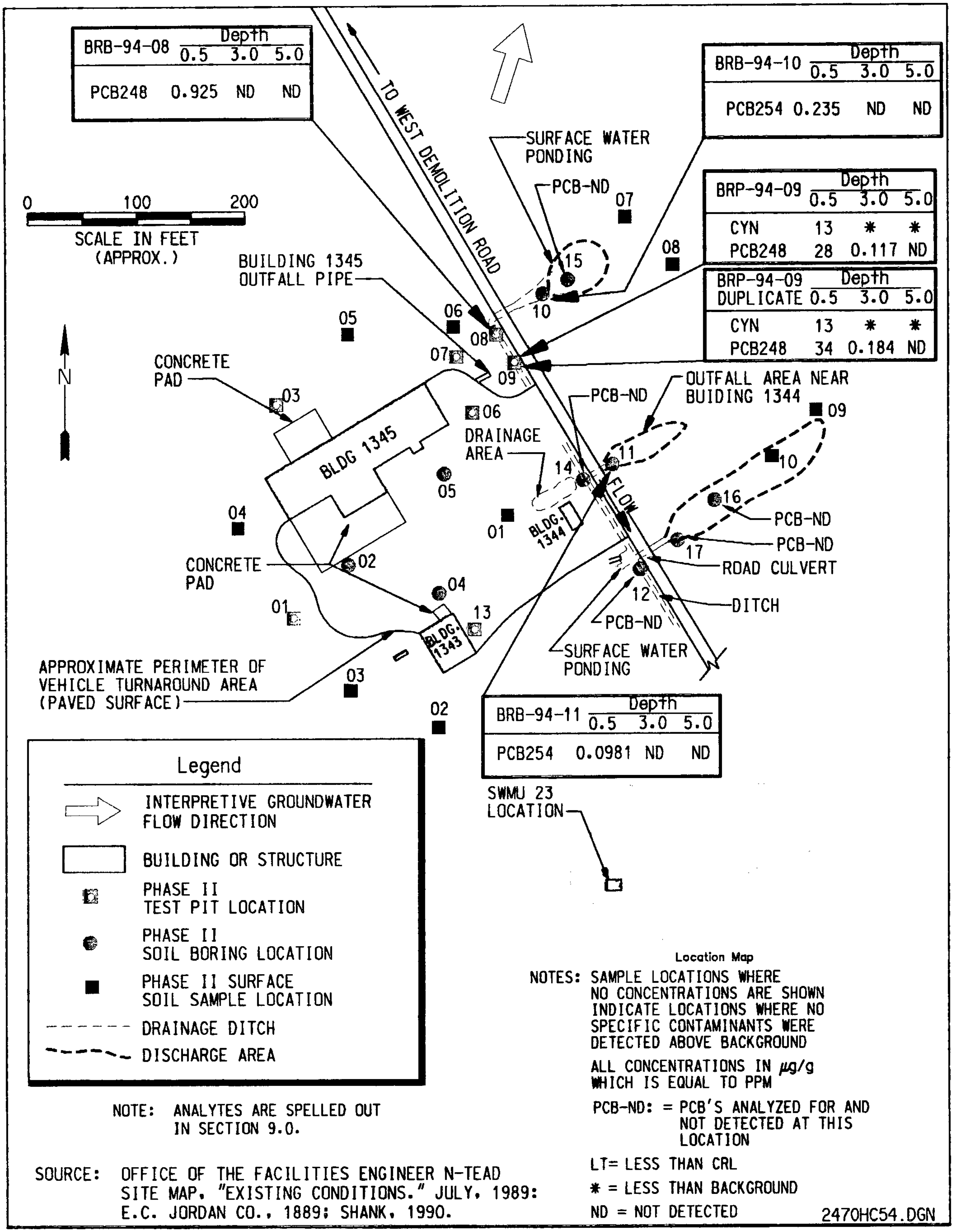

Figure 5-19. SWMU 23 Phase II Cyanide and PCB Results

5.5.3.3.3 ***Building 1345 Outfall.*** Building 1345 discharges wastewater from a floor drain through an outfall pipe to a ditch located north of the asphalt parking area and southwest of the road. Wastewater flow within this ditch continues to a culvert underlying the road that discharges to the wastewater ponding area located northeast of the road. The Building 1345 outfall discharge area was found to contain a variety of metals exceeding background, as well as PCBs, carcinogenic and noncarcinogenic PAHs, and other SVOCs.

Sediment sample BRD-92-02, collected from the outfall discharge point, contained elevated levels of silver (0.81 μg/g), cadmium (2.8 μg/g), chromium (470 μg/g), copper (99 μg/g), iron (35,000 μg/g), lead (860 μg/g), and zinc (1,100 μg/g) (see Figure 5-14). BRS-92-01, located northeast of the road where the wastewater collects, had levels of barium (260 μg/g), chromium (90 μg/g), iron (25,000 μg/g), lead (130 μg/g), and zinc (2,200 μg/g) above background threshold values.

During Phase II, test pits BRP-94-06 and -07 were excavated in the area of the Building 1345 outfall, and test pits BRP-94-08 and -09 were excavated within the ditch just below the outfall discharge point. These test pits also detected elevated concentrations of metals. The highest concentrations were found at the surface near the point of discharge, as shown in Figure 5-16. Concentrations rapidly decrease downstream with distance from the outfall. Soil boring BRB-94-10, located northeast of the road, contained cadmium (5.08 μg/g), chromium (39 μg/g), lead (79.1 μg/g), and zinc (727 μg/g) exceeding background in surface soil; chromium (58.1 μg/g) at the 3-foot interval; and chromium (66.6 μg/g) and nickel (30 μg/g) at the 5-foot interval in the subsurface. Sodium (at 352 μg/g) was the only metal detected above background in surface sample BRS-94-06, collected approximately 60 feet northeast of the outfall pipe. The Phase II samples indicated that metals contamination is limited to surface soils near the point of discharge and decreases to background conditions downstream in the wastewater ponding areas.

Cyanide contamination was detected in the sediment sample BRD-92-02 at a concentration of 41.1 μg/g, and in the surface soil sample BRP-94-09A and its duplicate at a concentration of 13 μg/g. These samples were collected where the outfall pipe discharges to the ditch. Cyanide concentrations significantly decrease to background values downstream (see Figure 5-18). Cyanide was not detected above background in any of the other surrounding surface soil samples or in any subsurface soil samples. These data indicate that cyanide contamination is limited to surface soil and sediment at the Building 1345 outfall discharge point.

PCB Aroclor 1248 was detected in surface soil and sediment at the Building 1345 outfall area. Sediment sample BRD-92-02 had a concentration of 5.2 μg/g. Test pit BRP-94-08A showed a concentration of 0.925 μg/g at the surface. Test pit BRP-94-09A had the highest concentration of PCBs at 28 μg/g and 34 μg/g in the duplicate sample (see Figure 5-19) collected at the surface. PCBs were also detected in the subsurface sample and its duplicate, collected at 3 feet in test pit BRP-94-09B, at concentrations of 0.117 and 0.184 μg/g, respectively. Soil boring BRB-94-10 was the farthest location downstream that showed a PCB 1254 detection at 0.235 μg/g in surface soil. Based on these data, the PCB contamination is very localized in the area of the Building 1345 outfall pipe discharge point where test pit BRP-04-09 was excavated and concentrations decreased significantly within the drainage swale.

Both carcinogenic and noncarcinogenic PAHs were detected in sediment sample BRD-92-02. Surface sample BRS-94-06 contained PAHs, as well as a number of other SVOCs. Soil borings BRB-94-06, -07, -08, and 09 also contained PAHs and other SVOCs in the surface samples (see Figures 5-17 and 5-18). With the exception of a low concentration of benzyl alcohol (0.083 $\mu g/g$) at the 5-foot depth in BRP-94-09, SVOCs were not detected in these samples below 3 feet.

5.5.3.3.4 *Asphalt Area and Stained Areas.* During Phase I, sample BRS-92-06, collected from an area of surface staining from a washdown area on the northeastern corner of Building 1343, showed elevated levels of copper (77 $\mu g/g$), mercury (0.174 $\mu g/g$), iron (23,000 $\mu g/g$), and lead (43 $\mu g/g$) (see Figure 5-14). During Phase II, soil borings BRB-94-02, -04, and -05 were drilled within the perimeter of the asphalt vehicle turnaround area. Silver, chromium, mercury, nickel, and vanadium were detected at concentrations exceeding background within these borings (see Figure 5-16). Silver was detected in only one sample from soil boring BRB-94-02 at the 3-foot depth interval at a concentration of 1.39 $\mu g/g$. Chromium in excess of background was detected in nearly every sample collected within the surface and subsurface soil, ranging from 27.4 to 162 $\mu g/g$. The exception was the 5-foot sample interval from soil borings BRB-94-04 and -05 where chromium was at background levels. All apparent Phase II mercury detections above background and the one nickel detection above background in the asphalt area were attributed to laboratory contamination. Mercury and nickel were detected in laboratory method blanks associated with these Phase II samples. Mercury was detected above background (0.174 $\mu g/g$) in Phase I sample BRS-92-06. Vanadium was detected in the 5-foot sample interval from boring BRB-94-05 at a concentration of 47.2 $\mu g/g$. Test pit BRP-94-13 was excavated adjacent to the stained area next to Building 1343. Mercury detected above background in this sample was attributed to laboratory contamination, as mercury was present in the associated method blank. Surface soil sample BRS-94-01, collected within the asphalt area, contained lead at concentrations slightly exceeding background (27.6 $\mu g/g$). Distribution of metals contamination in soil within the asphalt area appears to be limited to the top 3 feet of soil with the exception of vanadium.

Benzyl alcohol and a number of carcinogenic and noncarcinogenic PAHs were detected in surface and subsurface soil at this site. As with metals, these compounds were limited to the top 3 feet of soil, with two exceptions. Several PAHs were detected at the 5-foot interval in sample BRB-94-04. Benzyl alcohol was detected at a low concentration (0.067 $\mu g/g$) at a depth of 5 feet in sample BRB-94-02 (see Figure 5-18).

5.5.3.3.5 ***Perimeter Area.*** During Phase I of the RI, samples BRS-92-02, -03, -04, and -05 were collected from areas of surface staining outside the perimeter of the asphalt vehicle turnaround area. Metals detected above background in these samples included chromium (ranging from 22 to 80 $\mu g/g$), copper (ranging from 27 to 52 $\mu g/g$), nickel (26.3 and 25.8 $\mu g/g$), lead (ranging from 40 to 240 $\mu g/g$), and zinc (ranging from 120 to 300 $\mu g/g$). The highest concentration of lead was in sample BRS-92-04 (240 $\mu g/g$; see Figure 5-14). Test pits BRP-94-01 and -03 were excavated during Phase II along the western and northeastern

perimeter of the site, and surface soil samples BRS-94-01, -02, -03, -04, -05, -07, -08 were collected from areas surrounding the asphalt vehicle turnaround area and the Bomb and Shell Reconditioning buildings. Lead was detected in surface samples BRS-94-07 (30.1 $\mu g/g$) and BRP-94-01 (34.0 $\mu g/g$). Mercury detections above background in these samples were laboratory artifact, as mercury was detected in associated method blanks. Chromium exceeded background in the surface soil sample at BRP-94-01 at 23.3 $\mu g/g$. Surface soil samples BRS-94-09 and -10 were collected from far downstream in the discharge area for the Building 1343 outfall; these samples contained copper at 24.9 $\mu g/g$ and sodium at 350 $\mu g/g$, respectively. The perimeter sample locations define the lateral extent of metals contamination on all sides of the Bomb and Shell Reconditioning Site (see Figure 5-16).

SVOCs were infrequently detected in very low concentrations in perimeter surface and subsurface samples (see Figures 5-14, 5-17, and 5-18).

5.5.4 Human Health Risk Assessment

As part of the Phase II RI, an RA was conducted to estimate potential human health risks associated with the no-action alternative for SWMU 23, the Bomb and Shell Reconditioning Building. The following tasks were completed in the RA:

- Data analysis and selection of COPCs
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Conclusions and recommendations

This section provides a summary of the quantitative process employed at SWMU 23 and the results of that process. The RA for SWMU 23 is based on the methodology described in Section 3.1 and supported by Appendices L, M, N, and O.

5.5.4.1 *Selection of the Chemicals of Potential Concern—Soil*

As detailed in USEPA guidance (USEPA 1989a; USEPA 1994), a screening procedure can be used to narrow the list of contaminants at a particular site to a subset of analytes that can be considered the COPCs for the area. This screening procedure can involve up to four steps, depending on the contaminants present:

- Group data by chemical class (e.g., carcinogenic PAHs)
- Evaluate frequency of detection
- Evaluate essential nutrients
- Compare site data to risk-based screening concentrations (Region III values)

Below is the screening analysis for SWMU 23. For the purposes of this risk assessment, each area of concern was evaluated separately.

5.5.4.1.1 ***Building 1343 Outfall.*** Sample locations included in the evaluation of the Building 1343 Outfall were BRD-92-01, BRS-92-08 and -09, BRB-94-12, BRB-94-16, and BRB-94-17 (four surface samples and six subsurface samples).

Data Grouping. For the purposes of the risk assessment, a benzo(a)pyrene (B[a]P)-equivalent concentration of carcinogenic PAHs (c-PAHs) was calculated for each sample, as described in Section 3.1.1. Briefly, the concentration of each c-PAH detected within a sample was multiplied by its c-PAH-specific TEF to express the concentration in terms of B(a)P equivalents. The B(a)P equivalents were then summed to arrive at a total B(a)P-equivalent concentration for the sample.

If more than one PCB congener was detected in a sample, the concentrations were totaled to derive a total PCB concentration for that sample.

Frequency of Detection. Not enough samples were collected at the Building 1343 Outfall to undertake an evaluation of detection frequency.

Nutrient Screening. Iron was the only nutrient metal detected above background in surface soil at the Building 1343 Outfall. The maximum detected concentration (28,000 μg/g) was lower than the nutrient screening value (70,000 μg/g). Therefore, iron was eliminated as a COPC in surface soil. Sodium was detected above background in subsurface soil. The maximum detected concentration of sodium (445 μg/g) was less than the screening value (1,000,000 μg/g), and sodium was eliminated as a COPC.

Region III RBC Screening. The final step in the COPC selection process consisted of comparing the EPCs for remaining contaminants in surface and subsurface soil with Region III RBCs. However, before these comparisons were made, a "hot spot" analysis was conducted.

Hot Spot Analysis. For the final selection of COPCs, the site was evaluated for possible "hot spots." Since the samples collected at the Building 1343 Outfall were collected from an area approximately the size of a hypothetical 0.5-acre residential lot, all samples were combined for the calculation of the EPCs. Table 5-137 provides a summary of the EPCs for preliminary COPCs in surface and subsurface soil at the Building 1343 Outfall.

Soil-related Exposure Pathways. To select COPCs for the soil-related exposure pathways, the EPCs for the Building 1343 Outfall in surface and subsurface soil were compared to Region III soil ingestion and soil-to-air RBCs. As shown in Table 5-138, PCB 1254 was the only chemical that was retained as a COPC for soil-related pathways in surface soil. The only chemical retained as a COPC in subsurface soil was chromium.

Table 5-137. Summary of Preliminary Chemicals of Potential Concern (SWMU 23)

Chemical	Frequency of Detection[a]	Range of Detected Values (μg/g)[b]	Range of Reporting Limits (μg/g)	Arithmetic Mean Concentration (μg/g)	95% UCL[c] Concentration (μg/g)	Exposure Point Concentration[d] (μg/g)
Building 1343 Outfall - Surface Soil						
Chromium	4/4	13.0 - 23.1	NA[e]	18.9	29.0	23.1
Copper	4/4	16.7 - 170	NA	111	12,308	170
Lead	4/4	24.3 - 80.0	NA	50.8	287	80.0
Mercury	3/3[f]	0.092 - 0.199	NA	0.146	0.631	0.199
Silver	3/4	0.029 - 1.80	0.80	0.584	1.59E+05	1.80
Zinc	4/4	48.1 - 460	NA	275	13,684	460
Benzyl alcohol	1/1[g]	0.060	NA	NA	NA	0.060
Butyl benzyl phthalate	1/1[g]	0.470	NA	NA	NA	0.470
Dimethyl phthalate	1/1[g]	0.23	NA	NA	NA	0.23
PCB 1254	1/2	0.646	0.10	0.348	NA	0.646
Building 1343 Outfall - Subsurface Soil						
Cadmium	1/6	2.24	1.20	0.838	1.73	1.73
Chromium	6/6	14.3 - 54.6	NA	26.4	55.4	54.6
Lead	3/6	8.04 - 31.0	7.44	9.0	39.6	31.0
Silver	3/6	0.975 - 5.05	0.80	1.27	9.00	5.05
Bis(2-ethylhexyl) phthalate	1/6	0.90	0.48	0.338	0.695	0.695
Fluoranthene	2/6	0.054 - 0.160	0.03	0.042	0.277	0.160
Total carcinogenic PAHs[h]	1/1[h]	0.01411	NA	NA	NA	0.01411
Outfall Area Near Building 1344 - Surface Soil						
Cadmium	2/2	1.82 - 2.66	NA	2.24	NA	2.66
Chromium	2/2	39.2 - 43.6	NA	41.4	NA	43.6
Lead	2/2	100 - 115	NA	108	NA	115
Zinc	2/2	90.0 - 150	NA	120	NA	150
Acenaphthene	1/1[f]	0.330	NA	NA	NA	0.330
Benzo(g,h,i)perylene	1/1[f]	2.20	NA	NA	NA	2.20
Fluoranthene	1/1[f]	2.90	NA	NA	NA	2.90
Fluorene	1/1[f]	0.180	NA	NA	NA	0.180
Phenanthrene	1/1[f]	2.40	NA	NA	NA	2.40
PCB 1254	1/2	0.098	NA	NA	NA	0.098
Pyrene	1/1[f]	4.10	NA	NA	NA	4.10

Table 5-137. *Summary of Preliminary Chemicals of Potential Concern (SWMU 23) (continued)*

Chemical	Frequency of Detection[a]	Range of Detected Values (μg/g)[b]	Range of Reporting Limits (μg/g)	Arithmetic Mean Concentration (μg/g)	95% UCL[c] Concentration (μg/g)	Exposure Point Concentration[d] (μg/g)
Outfall Area Near Building 1344 - Surface Soil (continued)						
Total carcinogenic PAHs[h]	1/1[f]	0.677	NA	NA	NA	0.677
Outfall Area Near Building 1344 - Subsurface Soil						
Chromium	4/4	36.3 - 537	NA	171	83,196	537
Mercury	1/4	0.060	0.05	0.033	0.085	0.06
Nickel	4/4	5.90 - 19.8	NA	11.0	47.8	19.8
Acenaphthene	1/4	0.120	0.04	0.042	1.025	0.120
Fluoranthene	2/4	0.20 - 0.51	0.03	0.191	56,929	0.51
Phenanthrene	2/4	0.180 - 0.610	0.03	0.203	165,315	0.610
Pyrene	2/4	0.280 - 0.620	0.08	0.246	500	0.620
Total carcinogenic PAHs[h]	2/4	0.021 - 0.108	0.26	0.096	0.156	0.108
Building 1345 Outfall - Surface Soil						
Barium	8/8	57.3 - 260	NA	116	175	175
Cadmium	5/8	2.80 - 52.4	0.42 - 1.20	10.6	910	52.4
Chromium	8/8	9.83 - 470	NA	111	698	470
Cobalt	6/6[g]	3.49 - 10.5	NA	5.41	8.23	8.23
Copper	8/8	9.73 - 99.0	NA	32.7	92.3	92.3
Cyanide	4/8	1.12 - 41.1	0.25 - 5.0	7.33	4,660	41.1
Lead	8/8	9.84 - 860	NA	267	3,352	860
Silver	2/8	0.179 - 0.810	0.80	0.425	0.601	0.601
Zinc	8/8	39.1 - 2,200	NA	759	13,829	2,200
2-Methylnaphthalene	2/8	0.056 - 0.490	0.03 - 0.66	0.162	4.09	0.490
Acenaphthylene	1/6[g]	0.085	0.03	0.026	0.070	0.070
Acenaphthene	4/8	0.120 - 3.40	0.04 - 0.82	0.620	79.7	3.40
Anthracene	1/8	3.60	0.71 - 1.08	0.691	1.77	1.77
Benzo(g,h,i)perylene	5/8	0.370 - 2.30	0.18 - 0.48	0.541	2.56	2.30
Benzyl alcohol	3/6[i]	0.068 - 0.083	0.03	0.045	0.201	0.083
Bis(2-ethylhexyl)phthalate	5/8	1.10 - 7.20	0.48 - 0.78	2.02	16.0	7.20
Dibenzofuran	1/8	0.650	0.38 -0.66	0.277	0.422	0.422
Diethyl phthalate	1/8	0.530	0.24 - 0.66	0.219	0.430	0.430

Table 5-137. Summary of Preliminary Chemicals of Potential Concern (SWMU 23) (continued)

Chemical	Frequency of Detection[a]	Range of Detected Values (µg/g)[b]	Range of Reporting Limits (µg/g)	Arithmetic Mean Concentration (µg/g)	95% UCL[c] Concentration (µg/g)	Exposure Point Concentration[d] (µg/g)
***Building 1345 Outfall - Surface Soil* - (continued)**						
Di-n-butyl phthalate	2/8	1.50 - 1.90	0.66 - 1.30	0.827	1.62	1.62
Fluoranthene	7/8	0.180 - 5.50	1.04	1.12	6.42	5.50
Fluorene	2/8	0.290 - 2.00	0.07 - 0.66	0.343	8.98	2.00
Phenanthrene	7/8	0.180 - 9.50	0.82	1.59	18.0	9.50
Pyrene	7/8	0.410 - 10.0	0.84	1.88	9.13	9.13
Total PCBs[j]	4/7	0.235 - 34.0	0.32	3.83	4,039	34.0
Total carcinogenic PAHs[k]	7/8	0.017 - 6.40	0.19	0.667	66.4	6.40
Building 1345 Outfall - Subsurface Soil						
Chromium	10/12	3.81 - 66.6	1.69	24.7	157	66.6
Lead	6/12	8.90 - 21.8	7.44	7.85	12.7	12.7
Nickel	10/12	3.82 - 30.0	7.84	6.86	10.5	10.5
Benzyl alcohol	2/12	0.065 - 0 085	0.03	0.024	0.037	0.037
PCB 1248	1/12	0.184	0.10 - 0.32	0.098	0.155	0.155
Asphalt Area and Stained Areas - Surface Soil						
Chromium	6/6	8.90 - 162	NA	47.0	602	162
Copper	6/6	7.20 - 77.0	NA	19.6	91.1	77.0
Lead	4/6	10.3 - 43.0	7.44	16.5	135	43.0
Mercury	1/2[f]	0.174	0.05	0.099	NA	0.174
Nitrate	1/1	28.0	NA	NA	NA	28.0
2-Methylnaphthalene	1/5[f]	0.050	0.03	0.022	0.053	0.050
Acenaphthene	2/5[f]	0.110 - 0.360	0.04	0.095	9.64	0.360
Benzo(g,h,i)perylene	2/6	0.839 - 0.970	0.18	0.336	5.09	0.970
Benzyl alcohol	2/6	0.045 - 0.070	0.03 - 0.66	0.071	1.24	0.070
Fluoranthene	5/6	0.061 - 1.70	0.03	0.789	994	1.70
Fluorene	1/5[f]	0.200	0.07	0.060	0.401	0.200
Phenanthrene	5/6	0.110 - 1.80	0.03	0.797	224	1.80
Pyrene	5/6	0.220 - 3.00	0.08	1.41	160	3.00
Total carcinogenic PAHs[k]	5/6	0.00015 - 1.61	0.26	0.939	1.31E+09	1.61

Table 5-137. Summary of Preliminary Chemicals of Potential Concern (SWMU 23) (continued)

Chemical	Frequency of Detection[a]	Range of Detected Values (μg/g)[b]	Range of Reporting Limits (μg/g)	Arithmetic Mean Concentration (μg/g)	95% UCL[c] Concentration (μg/g)	Exposure Point Concentration[d] (μg/g)
Asphalt Area and Stained Areas - Subsurface Soil						
Chromium	6/8	14.5 - 116	1.69	50.8	4,489	116
Silver	1/8	1.39	0.80	0.511	0.763	0.763
Vanadium	3/8	16.9 - 47.2	2.93 - 3.74	11.0	183	47
2-Methylnaphthalene	3/8	0.082 - 0.250	0.03	0.073	0.576	0.250
Benzo(g,h,i)perylene	2/8	0.490 - 0.940	0.18	0.218	0.804	0.804
Benzyl alcohol	2/8	0.060 - 0.067	0.03	0.027	0.054	0.054
Fluoranthene	4/8	0.051 - 0.200	0.03	0.063	0.297	0.200
Phenanthrene	4/8	0.140 - 1.20	0.03	0.335	32.5	1.20
Pyrene	4/8	0.42 - 4.3	0.08	1.20	277	4.3
Total carcinogenic PAHs[k]	4/8	0.014 - 0.218	0.26	0.117	0.361	0.218
Perimeter Area - Surface Soil						
Chromium	14/14	7.3 - 80.0	NA	22.6	37.7	37.7
Copper	14/14	7.2 - 52.0	NA	18.4	26.0	26.0
Lead	14/14	12.6 - 240	NA	44.6	107	107
Nickel	12/14	3.14 - 26.3	2.46 - 4.90	8.28	15.6	15.6
Nitrate	2/4	5.95 - 6.59	3.36	4.00	46.7	6.59
Zinc	14/14	29.1 - 300	NA	74.2	115	115
Benzyl alcohol	1/10[l]	0.053	0.03	0.019	0.025	0.025
Fluoranthene	1/10[l]	0.045	0.03	0.019	0.024	0.024
Phenanthrene	2/10[l]	0.150 - 0.180	0.03	0.039	0.114	0.114
Perimeter Area - Subsurface Soil						
Benzyl alcohol	2/4	0.046 - 0.066	0.03	0.036	0.378	0.066

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]Micrograms per gram.
[c]Upper control limit.
[d]The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (USEPA 1989).
[e]Not applicable.
[f]One sample result was not included in the calculations due to a high CRL.
[g]Three sample results were not included in the calculations due to high CRLs.
[h]Five sample results were not included in the calculations due to high CRLs.
[i]Two sample results were not included in the calculations due to high CRLs.
[j]PCB 1248 and PCB 1254.
[k]Benzo(a)pyrene- equivalent concentration of total carcinogenic PAHs.
[l]Four sample results were not included in the calculations due to high CRLs.

Table 5-138. Selection of Chemicals of Potential Concern for Soil-related Pathways Based on EPA Region III's RBCs (SWMU 23)

	EPA[a] Region III RBC[b] Screen			
	Residential RBCs (μg/g)[c]			
Chemical	**Ingestion**	**Inhalation**	**Exposure Point Conc. (μg/g)**	**Retained as COPC?[d]**
Building 1343 Outfall - Surface Soil				
Chromium	39.0	140	23.1	No
Copper	310	NA[e]	170	No
Lead	400[f]	NA	80.0	No
Mercury	2.3	0.7	0.199	No
Silver	39.0	NA	1.80	No
Zinc	2,300	NA	460	No
Benzyl alcohol	2,300	NA	0.060	No
Butyl benzyl phthalate	1,600	53	0.470	No
Dimethyl phthalate	78,000	160	0.23	No
PCB 1254	0.083	NA	0.646	**YES**
Building 1343 Outfall - Subsurface Soil				
Cadmium	3.9	920	1.73	No
Chromium	39.0	140	54.6	**YES**
Lead	400[f]	NA	31.0	No
Silver	39.0	NA	5.05	No
Bis(2-ethylhexyl)phthalate	46	210	0.695	No
Fluoranthene	310	6.8	0.160	No
Total carcinogenic PAHs[g]	0.088	11	0.01411	No
Outfall Area Near Building 1344 - Surface Soil				
Cadmium	3.9	920	2.66	No
Chromium	39.0	140	43.6	**YES**
Lead	400[f]	NA	115	No
Zinc	2,300	NA	150	No
Acenaphthene	470	12	0.330	No
Benzo(g,h,i)perylene	230[h]	5.6[h]	2.20	No
Fluoranthene	310	6.8	2.90	No
Fluorene	310	8.9	0.180	No
Phenanthrene	230[h]	5.6[h]	0.098	No
PCB 1254	0.083	NA	0.098	**YES**
Pyrene	230	5.6	4.10	No
Total carcinogenic PAHs[g]	0.088	11	0.677	**YES**
Outfall Area Near Building 1344 - Subsurface Soil				
Chromium	39.0	140	537	**YES**
Mercury	2.3	0.7	0.06	No
Nickel	160	6,900	19.8	No
Acenaphthene	470	12	0.120	No
Fluoranthene	310	6.8	0.51	No
Phenanthrene	230	5.6	0.610	No
Pyrene	230	5.6	0.620	No
Total carcinogenic PAHs[g]	0.088	11	0.108	**YES**

Table 5-138. Selection of Chemicals of Potential Concern for Soil-related Pathways Based on EPA Region III's RBCs (SWMU 23) (continued)

	EPA[a] Region III RBC[b] Screen			
	Residential RBCs (μg/g)[c]			
Chemical	Ingestion	Inhalation	Exposure Point Conc. (μg/g)	Retained as COPC?[d]
Building 1345 Outfall - Surface Soil				
Barium	550	35,000	175	No
Cadmium	3.9	920	52.4	**YES**
Chromium	39.0	140	470	**YES**
Cobalt	470	NA	8.23	No
Copper	310	NA	92.3	No
Cyanide	160	NA	41.1	No
Lead	400[f]	NA	860	**YES**
Silver	39.0	NA	0.601	No
Zinc	2,300	NA	2,200	No
2-Methylnaphthalene	310[i]	18[i]	0.490	No
Acenaphthylene	230[h]	5.6[h]	0.070	No
Acenaphthene	470	12	3.4	No
Anthracene	2,300	0.68	1.77	**YES**
Benzo(g,h,i)perylene	230	5.6	2.30	No
Benzyl alcohol	2,300	NA	0.083	No
Bis(2-ethylhexyl)phthalate	46	210	7.20	No
Dibenzofuran	31	12	0.422	No
Diethyl phthalate	6,300	52	0.430	No
Dimethyl phthalate	78,000	160	0.460	No
Di-n-butyl phthalate	780	10	1.62	No
Fluoranthene	310	6.8	5.50	No
Fluorene	310	8.9	2.00	No
Phenanthrene	230[h]	5.6[h]	9.50	**YES**
Pyrene	230	5.6	9.13	**YES**
Total PCBs[j]	0.083	NA	34.0	**YES**
Total carcinogenic PAHs[g]	0.088	11	6.40	**YES**
Building 1345 Outfall - Subsurface Soil				
Chromium	39.0	140	66.6	**YES**
Lead	400[f]	NA	12.7	No
Nickel	160	6,900	10.5	No
Benzyl alcohol	2,300	NA	0.037	No
PCB 1248	0.083	NA	0.155	**YES**
Asphalt Area and Stained Areas - Surface Soil				
Chromium	39.0	140	162	**YES**
Copper	310	NA	77.0	No
Lead	400[f]	NA	43.0	No
Mercury	2.3	0.7	0.174	No
Nitrate	13,000	NA	28.0	No
2-Methylnaphthalene	310[i]	18[i]	0.050	No
Acenaphthene	470	12	0.360	No

Table 5-138. Selection of Chemicals of Potential Concern for Soil-related Pathways Based on EPA Region III's RBCs (SWMU 23) (continued)

	EPA[a] Region III RBC[b] Screen			
	Residential RBCs (μg/g)[c]			
Chemical	Ingestion	Inhalation	Exposure Point Conc. (μg/g)	Retained as COPC?[d]
Asphalt Area and Stained Areas - Surface Soil - (continued)				
Benzo(g,h,i)perylene	230[h]	5.6[h]	0.970	No
Benzyl alcohol	2,300	NA	0.070	No
Fluoranthene	310	6.8	1.70	No
Fluorene	310	8.9	0.200	No
Phenanthrene	230[h]	5.6[h]	1.80	No
Pyrene	230	5.6	3.00	No
Total carcinogenic PAHs[g]	0.088	11	1.61	**YES**
Asphalt Area and Stained Areas - Subsurface Soil				
Chromium	39.0	140	116	**YES**
Silver	49.0	NA	0.763	No
Vanadium	55.0	NA	47.2	No
2-Methylnaphthalene	310[i]	18[i]	0.250	No
Benzo(g,h,i)perylene	230[h]	5.6[h]	0.804	No
Benzyl alcohol	2,300	NA	0.054	No
Fluroanthene	310	6.8	0.200	No
Phenanthrene	230	5.6	1.20	No
Pyrene	230	5.6	4.3	No
Total carcinogenic PAHs[g]	0.088	11	0.218	**YES**
Perimeter Area - Surface Soil				
Chromium	39.0	140	37.7	No
Copper	310	NA	26.0	No
Lead	400[f]	NA	107	No
Nickel	160	NA	15.6	No
Nitrate	13,000	NA	6.59	No
Zinc	2,300	NA	115	No
Benzyl alcohol	2,300	NA	0.025	No
Fluoranthene	310	6.8	0.024	No
Phenanthrene	230[h]	5.6[h]	0.114	No
Perimeter Area - Subsurface Soil				
Benzyl alcohol	2,300	NA	0.066	No

Note.—RBCs were taken directly from the Region III RBC Table (USEPA 1995), except as noted in the footnotes. Values for noncarcinogens are 1/10 of the Region III RBC.

[a]U.S. Environmental Protection Agency.
[b]Risk-based calculations.
[c]Micrograms per gram.
[d]Chemicals of potential concern.
[e]Not applicable; value could not be calculated.
[f]One-tenth of OSWER recommended clean-up level for lead in residential soil (USEPA 1995).
[g]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
[h]Value for pyrene.
[i]Value for naphthalene.
[j]PCB 1248 and PCB 1254.

5.5.4.1.2 ***Outfall Area Near Building 1344.*** Sample locations included in the evaluation of the Outfall Area near Building 1344 were BRS-92-07, BRB-94-11, and BRB-94-14 (two surface samples and four subsurface samples).

Data Grouping. Data groupings for c-PAHs and PCBs were performed in the manner described above in Section 5.5.4.1.1.

Frequency of Detection. Not enough samples were collected at the Outfall Area near Building 1344 to undertake an evaluation of detection frequency.

Nutrient Screening. No nutrient metals were detected above background in either surface or subsurface soil at this area of concern.

Region III RBC Screening. The final step in the COPC selection process consisted of comparing the EPCs for remaining contaminants in surface and subsurface soil with Region III RBCs. However, before these comparisons were made, a "hot spot" analysis was conducted.

Hot Spot Analysis. For the final selection of COPCs, the site was evaluated for possible "hot spots." Since the samples collected at the Outfall Area near Building 1344 were collected from an area approximately the size of a hypothetical 0.5-acre residential lot, all samples were combined for the calculation of the EPCs. Table 5-137 provides a summary of the EPCs for preliminary COPCs in surface and subsurface soil at the Outfall Area near Building 1344.

Soil-related Exposure Pathways. To select COPCs for the soil-related exposure pathways, the EPCs for the Outfall Area near Building 1344 in surface and subsurface soil were compared to Region III soil ingestion and soil-to-air RBCs. As shown in Table 5-138, three chemicals were retained as COPCs for soil-related pathways in surface soil: chromium, PCB 1254, and total c-PAHs (benzo[a]pyrene equivalents). The chemicals retained as COPCs in subsurface soil were chromium and total c-PAHs.

5.5.4.1.3 ***Building 1345 Outfall.*** Sample locations included in the evaluation of the Building 1345 Outfall were BRS-92-01, BRD-92-02, BRS-94-06, BRB-94-10 and -15, and BRP-94-06, -07, -08, and -09 and its duplicate (8 surface samples (and 1 duplicate) and 12 subsurface samples (and 2 duplicates)).

Data Grouping. Data groupings for c-PAHs and PCBs were performed in the manner described above in Section 5.5.4.1.1.

Frequency of Detection. Not enough samples were collected at the Building 1345 Outfall to undertake an evaluation of detection frequency.

Nutrient Screening. The nutrients detected above background in surface soil had maximum concentrations less than their nutrient screening values: iron (maximum—35,000 μg/g; screening value—70,000 μg/g) and sodium (maximum value—352 μg/g, screening value—1,000,000 μg/g). Therefore, these nutrients were eliminated as COPCs in surface soil.

Sodium was the only nutrient detected above background in subsurface soil. The maximum detected value of sodium, 396 $\mu g/g$, was less than the nutrient screening value for this chemical (1,000,000 $\mu g/g$). Therefore, sodium was eliminated as a COPC in subsurface soil at the Building 1345 Outfall.

Region III RBC Screening. The final step in the COPC selection process consisted of comparing the EPCs for remaining contaminants in surface and subsurface soil with Region III RBCs. However, before these comparisons were made, a "hot spot" analysis was conducted.

Hot Spot Analysis. For the final selection of COPCs, the SWMU was evaluated for possible "hot spots." Since the samples collected at the Building 1345 Outfall were collected from an area approximately the size of a hypothetical 0.5-acre residential lot, all samples were combined for the calculation of the EPCs. Table 5-137 provides a summary of the EPCs for preliminary COPCs in surface and subsurface soil at the Building 1345 Outfall.

Soil-related Exposure Pathways. To select COPCs for the soil-related exposure pathways, the EPCs for the Building 1345 Outfall in surface and subsurface soil were compared to Region III soil ingestion and soil-to-air RBCs. As shown in Table 5-138, cadmium, chromium, lead, anthracene, phenanthrene, pyrene, total PCBs, and total c-PAHs were retained as COPCs for soil-related pathways in surface soil. The chemicals retained as COPCs in subsurface soil were chromium and PCB 1248.

5.5.4.1.4 ***Asphalt Area.*** Sample locations included in the evaluation of the Asphalt Area were BRS-92-06, BRS-94-01, BRB-94-02, 04, and -05, and BRP-94-13 (six surface samples and eight subsurface samples).

Data Grouping. Data grouping for c-PAHs was performed in the manner described above in Section 5.5.4.1.1.

Frequency of Detection. Not enough samples were collected at the Asphalt Area to undertake an evaluation of detection frequency.

Nutrient Screening. Iron was the only nutrient detected above background in surface soil. The maximum detected value of iron, 23,000 $\mu g/g$, was less than the nutrient screening value for this chemical (70,000 $\mu g/g$). Therefore, iron was eliminated as a COPC in surface soil at the Asphalt Area. No nutrient metals were detected above background in subsurface soil.

Region III RBC Screening. The final step in the COPC selection process consisted of comparing the EPCs for remaining contaminants in surface and subsurface soil with Region III RBCs. However, before these comparisons were made, a "hot spot" analysis was conducted.

Hot Spot Analysis. For the final selection of COPCs, the site was evaluated for possible "hot spots." Since the samples collected at the Asphalt Area were collected from an area approximately the size of a hypothetical 0.5-acre residential lot, all samples were combined for

the calculation of the EPCs. Table 5-137 provides a summary of the EPCs for preliminary COPCs in surface and subsurface soil at the Asphalt Area.

Soil-related Exposure Pathways. To select Asphalt Area COPCs for the soil-related exposure pathways, the EPCs for the in surface and subsurface soil were compared to Region III soil ingestion and soil-to-air RBCs. As shown in Table 5-138, chromium and total c-PAHs were the only chemicals retained as COPCs for soil-related pathways in surface soil. Chromium and total c-PAHs were also retained as COPCs in subsurface soil.

5.5.4.1.5 *Perimeter Area.* Sample locations included in the evaluation of the Perimeter Area were BRS-92-02, -03, -04, and -05, BRS-94-02, -03, -04, -05, -07, -08, -09, and -10, and BRP-94-01 and -03 (14 surface samples and 4 subsurface samples).

Data Grouping. No data grouping was necessary for the perimeter area.

Frequency of Detection. Not enough samples were collected at the Asphalt Area to undertake an evaluation of detection frequency.

Nutrient Screening. Magnesium and sodium were detected above background in surface soil in the Perimeter Area. The maximum concentrations of these chemicals were less than their respective nutrient screening values: magnesium (maximum—8,060 μg/g; screening value—1,000,000 μg/g); sodium (maximum value—350 μg/g; screening value—1,000,000 μg/g). Therefore, magnesium and sodium were eliminated as COPCs in surface soil. No nutrient metals were detected above background in subsurface soil in the Perimeter Area.

Region III RBC Screening. The final step in the COPC selection process consisted of comparing the EPCs for remaining contaminants in surface and subsurface soil with Region III RBCs. However, before these comparisons were made, a "hot spot" analysis was conducted.

Hot Spot Analysis. For the final selection of COPCs, the site was evaluated for possible "hot spots." Because contamination was minimal in samples collected from the perimeter area, all samples were combined to estimate the EPCs for the Perimeter Area of the site (see Table 5-137).

Soil-related Exposure Pathways. To select COPCs for the soil-related exposure pathways, the EPCs for the Perimeter Area in surface and subsurface soil were compared to Region III soil ingestion and soil-to-air RBCs. As shown in Table 5-138, no chemicals were retained as COPCs in the Perimeter Area.

5.5.4.1.6 *Site-wide Soils.* Concentrations of the COPCs for surface soils—cadmium, chromium, lead, anthracene, phenanthrene, pyrene, PCBs, and total c-PAHs—were calculated on a site-wide basis for the purpose of evaluating site-wide exposure scenarios. Site-wide concentrations were calculated utilizing all surface soil samples collected at SWMU 23. The site-wide concentrations of these surface soil COPCs are provided in Table 5-139.

Table 5-139. Site-Wide Surface Soil Exposure Point Concentrations of Chemicals of Potential Concern (SWMU 23)

Chemical	Frequency of Detection[a]	Range of Detected Values (μg/g)	Range of Reporting Limits (μg/g)	Arithmetic Mean Concentration (μg/g)	95% UCL Concentration (μg/g)	Exposure Point Concentration[b] (μg/g)
Cadmium	8/34	0.515 - 52.4	0.4 2 - 1.20	1.63	2.90	2.90
Chromium	34/34	7.30 - 470	NA[c]	43.9	67.5	67.5
Lead	32/34	9.84 - 860	7.44	87.2	177	177
Anthracene	1/34	3.60	0.71 - 10.8	0.984	1.57	1.57
Phenanthrene	15/34	0.110 - 9.50	0.032 - 8.20	2.08	11.4	9.50
Pyrene	13/34	0.220 - 10.0	0.083 - 8.40	2.11	8.44	8.44
PCBs	6/25	0.098 - 34.0	0.20 - 0.64	0.568	1.38	1.38
Total carcinogenic PAHs	13/34	0.0002 - 6.399	0.096 - 1.93	0.690	2.27	2.27

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
[c]Not applicable.

5.5.4.2 *Selection of Chemicals of Potential Concern-Air*

For all receptors with the exception of the construction worker, the air pathway (i.e., inhalation of particulates) is evaluated on a SWMU-wide basis rather than by area of concern. Because all COPCs in soils were either metals or semi-volatile organics with very low volatility, potential exposures to wind-blown particulate would be contributed to by the entire SWMU (as well as exposed soil outside the defined SWMU), regardless of the specific SWMU-related activity. This was also assumed to hold true for potential off-site receptors. Air emissions of SWMU-related chemicals were assumed to occur by entrainment from wind erosion of particulate-bound COPCs. With entrainment, it is assumed that small amounts of the organic compounds or heavy metals become airborne and adsorb onto the surface of dust particles.

A volatilization emission analysis was performed (SEC Donahue 1992b) using a volatilization release estimation equation designed for chemicals spilled or incorporated into soils (USEPA 1988a). Results from this analysis indicated negligible air quality impacts derived from volatilization releases from SWMUs located at TEAD. In addition, results from previous modeling conducted for adjacent sites with similar VOC concentrations revealed insignificant releases (SEC Donahue 1992b).

For current and future on-site receptors, COPC retained for the soil pathways were used to evaluate exposures from air. For current off-site receptors, exposure point concentrations generated for COPCs retained for the on-site soil pathways were modeled using SCREEN2 to estimate the air quality impacts at selected sites surrounding TEAD. To maintain a health-protective approach, the RME EPC for children was used as the input soil concentration to the model. Off-site air concentrations generated by the model were screened against USEPA Region III Risk-Based Concentrations guidance to verify the negligible contribution of this pathway. SCREEN2 is a single-source, screening-level model that has algorithms to estimate air quality impacts associated with air sources. For a complete description of the SCREEN2 model and associated results, see Appendix N. As shown in Table 5-140, based on comparison to air RBCs, only the predicted concentration for chromium (as Cr VI) at the nearest property boundary exceeded the RBC. This was not considered a cause for concern because:

- The RBC corresponds to a 10^{-6} incremental lifetime cancer risk using a health-protective exposure model. The boundary concentration was estimated using a conservative model employing worst-case meteorological conditions. Even so, the predicted boundary concentration is less than 3 times the RBC, implying that the associated risk would remain on the order of 10^{-6}, still near the lower bound established in the NCP.

- Actual risk estimates for this pathway for an on-site residential scenario use an estimated EPC an order of magnitude higher than that predicted by the SCREEN2 model for the nearest property boundary. However, the RME child and adult ILCR using the exposure scenario for residential exposure developed specifically for the TEAD risk assessment are on the order of 10^{-6}, well within the acceptable range.

Table 5-140. Selection of Chemicals of Potential Concern for Off-site Air-related Pathways Based on EPA Region III's Risk-Based Concentration Screening Guidance (SWMU 23)

		EPA Region III Risk-Based Concentration[a] Screen ($\mu g/m^3$)[b]					
Chemical	RME SWMU-wide Soil Exposure Point Conc. (mg/kg)[c]	Exposure Point Conc. at Property Line	Exposure Point Conc. at Grantsville	Exposure Point Conc. at Tooele	Exposure Point Conc. at Stockton	Ambient Air RBC	Retained as off-site COPC[d]?
Cadmium	2.9	0.000017	0.0000034	0.0000014	0.0000016	0.00099	No
Chromium[e]	67.5	0.00040	0.000080	0.000032	0.000037	0.00015	Yes
Lead	177	0.0010	0.00021	0.000083	0.000098	1.5[f]	No
Anthracene	0.16	0.00000059	0.00000012	0.000000047	0.000000055	110	No
Phenanthrene	0.42	0.0000015	0.00000030	0.00000012	0.00000014	Not Available	No[h]
Pyrene	3.2	0.000012	0.0000025	0.00000097	0.0000011	11	No
PCBs	1.38	0.0000081	0.0000016	0.00000065	0.00000076	0.00081	No
Total Carcinogenic PAHs[g]	0.26	0.00000094	0.00000019	0.000000075	0.000000088	0.001	No

[a]Values for noncarcinogens are 1/10th of the Region III RBC (USEPA 1996).
[b]Micrograms per cubic meter.
[c]Milligrams per kilogram.
[d]Chemicals of potential concern.
[e]RBC value for chromium VI assumed.
[f]National Ambient Air Quanlity Standard.
[g]Polynuclear aromatic hydrocarbons; benzo(a)pyrene-equivalent total c-PAH concentration.
[h]Not retained for quantitative evaluation due to a lack of toxicity information.

For these reasons, no further quantitative evaluation of off-site inhalation of chromium particulate is necessary.

5.5.4.3 *Selection of the Chemicals of Potential Concern—Groundwater*

The selection of COPCs for the groundwater exposure pathways consist of a two-phase modeling approach. Initially, the *maximum* concentration of each analyte detected in either surface or subsurface soil was compared to the Region III soil-to-groundwater RBC. One-tenth of the value was used for noncarcinogens. If the maximum concentration of a chemical exceeded the soil-to-groundwater RBC, the chemical was selected for vadose zone modeling (Table 5-141). The modeled break-through concentration in groundwater for these chemicals was then compared to the Region III tap water RBCs, with one-tenth of the value used for noncarcinogens. In addition, the modeled break-through time was compared to the 100-year cut-off period as described in Section 2.7.2. A chemical that reached the water table within 100 years *and* had a modeled break-through concentration that exceeded the Region III tap water RBC (one-tenth of the value for noncarcinogens) was retained for further vadose-saturated zone modeling to on- and off-site hypothetical receptors as described in Section 2.7.2. For this second phase of modeling, the *average* surface and subsurface soil concentration was used to calculate the initial pore water concentration at the site. Again, the vadose-saturated zone modeling results were compared to the Region III tap water RBCs, with one-tenth for noncarcinogens. If the chemical still failed to meet the 100-year break-through criteria *and* exceeded the Region III tap water RBC, it was retained for quantitative risk assessment. As shown in Table 5-141, barium, cadmium, chromium, copper, lead, nickel, vanadium, total PCBs, total c-PAHs, and cyanide were retained for vadose zone modeling at SWMU 23.

5.5.4.3.1 ***Vadose Zone Model Results.*** The soil screening described in the previous sections indicated that 10 COPCs should be evaluated using the soil-vadose-zone-groundwater-screening model at SWMU 23. These COPCs consist of the seven metals, total PCBs, total c-PAHs, and cyanide as indicated in Table 5-141 of the previous section. The vadose-zone modeling set-up procedures are described in detail in Section 2.7.2 of this report. This section defines the site-specific parameters and presents the vadose-zone modeling results.

The SWMU 23 site-specific input parameters are defined as the thickness of the vadose zone (H cm), the area of contamination (CA m^2), and the thickness of the contaminated zone (H cont, cm). These input parameters, along with the COPC chemical-specific parameters are used as the input for the GWM-1 and MULTIMED models. An example of a GWM-1 spreadsheet model for SWMU-23 is shown in Appendix K. As the figure in Appendix K indicates, the above site-specific parameters for SWMU 23 are as follows:

H	=	16,764 cm
CA	=	25,230 m^2
H cont	=	90 cm

Table 5-141. Selection of COPCs for Groundwater Exposure Pathways (SMWU 23)

Chemical	Maximum Above Background (µg/g)[a]	Depth	Soil-to-GW RBC[b] (µg/g)	Selected for Vadose Zone Modeling?	Reached Water Table Within 100 Years	Model Output: Exposure Point Concentration in Groundwater (mg/L)[c]	Tap Water RBC (mg/L)	Selected as COPC[d] for Groundwater[e]?
2-Methylnaphthalene	0.49	Surface	3.0[f]	No	---	---	---	---
Acenaphthylene	0.085	Surface	140[g]	No	---	---	---	---
Acenaphthene	3.4	Surface	20	No	---	---	---	---
Anthracene	3.6	Surface	430	No	---	---	---	---
Barium	260	Surface	3.2	YES	No	.0013	0.260	No
Benzo(g,h,i)perylene	2.3	Surface	140[g]	No	---	---	---	---
Benzyl alcohol	0.083	Subsurface	2.5[h]	No	---	---	---	---
Bis(2-ethylhexyl)phthalate	7.2	Surface	11	No	---	---	---	---
Butyl benzyl phthalate	0.47	Surface	6.8	No	---	---	---	---
Cadmium	52.4	Surface	0.6	YES	No	.0158	.0018	No
Chromium	537	Subsurface	1.9	YES	No	0.4777	.018	No
Cobalt	10.5	Surface	119[h]	No	---	---	---	---
Copper	170	Surface	31[h]	YES	No	0.4442	0.140	---
Cyanide	41.1	Surface	0.04	YES	No	.008	---	---
Dibenzofuran	0.65	Surface	12	No	---	---	---	---
Diethyl phthalate	0.53	Surface	11	No	---	---	---	---
Dimethyl phthalate	0.46	Surface	120	No	---	---	---	---
Di-n-butyl phthalate	1.9	Surface	12	No	---	---	---	---
Fluoranthene	5.5	Surface	98	No	---	---	---	---
Fluorene	2.0	Surface	16	No	---	---	---	---
Lead	860	Surface	15[h]	YES	No	.0926	.015[i]	No
Mercury	0.199	Surface	0.3	No	---	---	----	---
Nickel	30	Subsurface	2.1	YES	No	---	.073	No
Phenanthrene	9.5	Surface	140	No	---	---	---	---
Pyrene	10	Surface	140	No	---	---	---	---
Silver	5.05	Subsurface	19[h]	No	---	---	---	---
Vanadium	47.2	Subsurface	5.2[h]	YES	No	---	.026	No

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Table 5-141. *Selection of COPCs for Groundwater Exposure Pathways (SMWU 23) (continued)*

Chemical	Maximum Above Background (µg/g)[a]	Depth	Soil-to-GW RBC[b] (µg/g)	Selected for Vadose Zone Modeling?	Reached Water Table Within 100 Years	Model Output: Exposure Point Concentration in Groundwater (mg/L)[c]	Tap Water RBC (mg/L)	Selected as COPC[d] for Groundwater[e]?
Total PCBs	34	Surface	8.2	YES	No	---	.0000087	No
Total carcinogenic PAHs[j]	6.4	Surface	4	YES	No	.0012	.0000092	No

Note.—RBCs were taken directly from the Region III RBC Table except as indicated in the footnotes.
[a]Micrograms per gram.
[b]Risk-based calculations.
[c]Milligrams per liter.
[d]Chemicals of potential concern.
[e]Selected as COPC if the chemical reached the water table within 100 years and exceeded the tap water RBC.
[f]Value for naphthalene.
[g]Value for pyrene.
[h]Calculated according to Region III guidance (USEPA 1995)
[i]Action level for lead (USEPA 1995)
[j]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.

Other key COPC-specific parameters—the distribution coefficient (Kd), the maximum observed soil concentration (Tc), the initial pore water concentration (C_{init}), and the plume pulse duration (p.d.)—are also shown in Appendix K. All of the GWM-1 spreadsheets associated with the SWMU-specific COPCs are in Appendix K along with the MULTIMED output concentrations. Table 5-142 summarizes these COPC-specific parameters and shows the MULTIMED output for COPC break-through time (time after leaching starts, that the leading edge of the COPC plume reaches the top of the water table) along with the COPC estimated concentration at the time that breakthrough occurs. One key to interpreting these estimates is that the pore water concentration was determined by starting with the maximum observed soil concentration at the site (see Table 5-142) and calculating the maximum concentration available for the pore water solution by soil-water partitioning. As explained in Section 2.7, the equation used is very dependent on Kd and does not take into account mineral solubility and equilibrium relationships. This is evident by some of the high C_{init} concentrations estimated for several of the COPCs.

5.5.4.3.2 ***Groundwater COPCs.*** As shown in the previous sections and in Table 5-142, the MULTIMED output indicates that within a 100-year time period, none of the SWMU 23 COPCs will travel downward through the vadose zone and reach the water table. As discussed in detail in Section 2.7.2, the conservative approach was the basis for the model calculations.

Table 5-142 illustrates this concept, showing the critical input and output parameters and the estimated break-through time for each COPC. This table also shows the estimated concentration associated with the arrival of the leading edge of the COPC plume at the water table. Again, it should be noted that the break-through time calculation does not take into account the various retardation influences, such as biodegradation, volatilization, absorption, adsorption, and mineral-solution equilibrium relationships.

The break-through time for COPCs ranged from 1,250 years for cyanide to over 91,000 years for nickel, vanadium, and total PCBs. These results indicate that the groundwater exposure pathway is not complete for the various scenarios evaluated for SWMU 23. Therefore, no chemicals for SWMU 23 were considered in the quantitative risk assessment.

5.5.4.4 *Exposure Pathway Assessment*

Exposure is defined as the contact of a receptor with a chemical (USEPA 1989). Exposure assessment is the estimation of the magnitude, frequency, and duration for each identified route of exposure. The magnitude of an exposure is determined by estimating the amount of chemical available at the receptor exchange boundaries (i.e., lungs, gastrointestinal tract, or skin) during a specified time period. Section 3.1.2 describes the general tasks comprising the exposure assessment. The specific application of these tasks to SWMU 23 is described below.

Table 5-142. Summary of Vadose Zone Break-Through Modeling Results and Critical I/O GWM-1 and MULTIMED Parameters for SWMU 23

		COPC[a] Specific Parameters				
Analyte	**Kd[b]**	**Tc[c] (max) (ppm)[d]**	**C_{init}[e] (mg/L)[f]**	**Breakthrough Time (yrs)**	**Breakthrough Conc. (mg/L)**	**p.d.[g] (yrs)**
Barium	52	260	5.54	60,000	0.0013	808
Cadmium	1.3	52.4	41.3	1600	0.0158	22
Chromium	1.2	537	455	1500	0.4777	20
Copper	1.4	170	125	1800	0.4442	23
Lead	4.5	860	207	5300	0.0926	71
Nickel	150	30	0.222	>91000	ND[h]	2326
Vanadium	1000	47.2	0.0524	>91000	ND	15498
Total PCBs	204	34	0.185	>91000	ND	3136
Total c-PAHs	19	6.4	0.372	23000	0.0012	296
Cyanide	1	41.1	41.1	1250	0.008	17

Note.—Site-specific parameters are as follows: vadose zone thickness (H) = 16,764 cm; area of contaminated soil (CA) = 25,230 m^2; thickness of contaminates soil (Hcont) = 90 cm.

[a]Chemicals of potential concern.
[b]Distribution coefficient and is dimensionless.
[c]Maximum observed soil concentration (ppm).
[d]Parts per million.
[e]Pore water concentration at the source as conservatively calculated by GWM-1.
[f]Milligrams per liter.
[g]Pulse duration as calculated by GWM-1.
[h]Not determined.

5.5.4.4.1 *Characterization of Exposure Setting*. The first step in developing exposure scenarios for SWMU 23 was to characterize the site setting in which potential exposures might occur. The characteristics of the site setting influence the types of transport mechanisms and the type of receptor exposure that could occur. The site setting also provides a basis for identifying the potential receptors (either real or, in the case of site redevelopment for alternative use, hypothetical). Both current land use patterns and future land use patterns were examined as part of the characterization.

Current Land Use. As is true for other areas of TEAD-N, public access to SWMU 23 is controlled, thereby precluding transient exposure. SWMU 23 is located in the south-central portion of TEAD-N and will remain part of the depot mission for the foreseeable future. The Bomb and Shell Reconditioning Building has been identified as a location likely to have future activity that could require on-site workers to be at this SWMU 10 hours per day, 4 days per week.

Based on the above information, potential receptors under current land use were defined as SWMU-specific laborers and security personnel. These include individuals with job descriptions that call for repeated, light to moderate labor in the general vicinity of SWMU 23 and staff members assigned to maintenance of the perimeter and security personnel that repeatedly work in the vicinity of SWMU 23.

It was assumed that the SWMU-specific laborer scenario would provide a sufficient upper bound on risk. Because other potential receptors would be exposed only intermittently to SWMU 23, SWMU-specific laborers and security personnel were the only receptors evaluated quantitatively as a current-use scenario. This approach provides a series of upper-bound estimates.

Cattle grazing is permitted at TEAD-N, with grazing allotments competitively bid and leased every 5 years to a single rancher. The current lease is up for rebid in 1996. Grazing at TEAD-N typically occurs between October 15 and May 31, with calving taking place in January. The calves remain at the facility until May 31 when they are either moved to feedlots or to other grazing areas. The calves typically do not return to TEAD-N after their initial exposure, and they are eventually sold as slaughter cattle for human consumption. Distribution is through regional and national distribution networks. The cows are normally utilized as breeding stock and may or may not return to the site during consecutive years. The current lessee brings approximately 1,000 head, mostly heifers, to winter pasture at TEAD-N and maintains summer pasture in Idaho (M. Walker, personal communication with Rust E&I, 1994).

SWMU 23 is one of several SWMUs on one grazing allotment currently under lease. Consumption of beef grazed on the allotment of which SWMU 23 is a part is evaluated in a separate section (Section 5.7.1) of the risk assessment.

Future Land Use. It was assumed that no change in current use other than the aforementioned activity is planned for the SWMU 23 vicinity. Current BRAC recommendations retain SWMU

23's function as part of the depot's mission. However, should the mission of TEAD-N change in the future, two additional exposure scenarios unique to planned or potential future use of SWMU 23 were developed:

- Skilled laborers—Individuals assigned to short-term construction in the vicinity of SWMU 23 during potential redevelopment.

- Inhabitants of an on-site residence(s)—Individuals who live in residences established at the time that depot property should ever be transferred for redevelopment.

5.5.4.4.2 ***Characterization of Potential Exposure Pathways***. An exposure pathway is the route COPCs take to reach potential receptors. Section 3.1.2.1 and 3.1.2.2 describe the methodology for characterization of exposure pathways. This methodology was then applied to SWMU 23. The following sections describe the potential exposure pathways associated with SWMU 23 for the current and future land use scenarios.

Current Land Use. Currently, the majority of laborers at TEAD-N work 10-hour days with 4-day weeks. A total of 4 weeks off a year for vacation, holidays, and sick leave yields 192 days per year on the job. It is assumed that a laborer could be at any specific SWMU from 2 to 10 hours per day and will incidentally ingest, inhale, or become in contact with surface soil through work-related activities. Military personnel are rotated on assignment an average of every 3 years (S. Culley, personal communication with Rust E&I, 1994). If a laborer is a civilian, the length of assignment could be expected to range as high as 25 years. It is assumed that all of the exposure is from outdoor tasks or activities. Specific parameters relating to ingestion, contact, and ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

Future Land Use. Current BRAC recommendations retain SWMU 23's function as part of the depot's mission. Based on the future continued usage of SWMU 23, it is possible that industrial construction may be conducted to increase the capacity of the military operations at TEAD-N. For these reasons, the future construction worker scenario was evaluated. It is assumed that a construction company could be contracted for a work period ranging from 1 to 3 years and a single worker could be at the site conducting activities outdoors from 2 to 4 months of the year. It is assumed that a worker works as much as 8 to 10 hours per day and may incidentally ingest, inhale, or come in contact with subsurface soil through construction-related activities. Specific parameters relating to ingestion, contact, and ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

Should the future planned use of SWMU 23 change and the property be zoned for potential residential development, the future on-site adult and child resident would also be evaluated for the future land use scenario. For the future on-site adult resident, it was assumed that at least one parent would spend much of his or her time away from home in activities such as working at another location, household errands, personal care (e.g., medical/dental appointments), or leisure activities. Based on this assumption, the total estimated time an adult will spend at

home is approximately 15 to 19 hours per day during which time he or she may incidentally ingest, inhale, or come in contact with surface soil while conducting activities such as gardening, mowing, or outdoor sports. It is also expected that the future on-site resident will grow and harvest vegetables and fruits from a home garden. For children and adolescents ages 0 to 18, time activity patterns indicate that they spend an average of approximately 30 hours per week away from home to attend school or day care. The total time a child spends at home, averaged over a 7-day week, is approximately 20 hours per day. It is assumed that residents spend 2 (RME) to 4 (CTE) weeks away from home on vacation or long holiday weekends. Therefore, the exposure frequency in real time is 335 days per year (CTE) to 350 days per year (RME). Because the contact rate for ingestion and dermal exposure is in daily units, the exposure frequency for these pathways is prorated into 24-hour-day equivalents. This ranges from 216 days per year (CTE adult) to 276 days per year (CTE child) and from 273 days per year (RME adult) to 288 days per year (RME child) (see Appendix L). Years spent at one residence for the adult/child range from 8 (CTE) to 30 (RME) years based on studies compiled by the USEPA (1989c) and AIHC (1994). Specific parameters relating to ingestion, contact, ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

5.5.4.5 *Exposure Point Concentrations*

The EPC is defined as the concentration of a COPC in an exposure medium that will be contacted over a real or hypothetical exposure duration. EPCs at SWMU 23 were evaluated for current and future land use. Estimation of EPCs is fully described in Appendix L. For brevity, only information specific to SWMU 23 is presented in the following sections.

As discussed in Sections 5.5.4.1 and 5.5.4.2, five areas of concern were evaluated for SWMU 23. Based on the screening methodology, EPCs were estimated for COPCS in surface and/or subsurface soils for four of the areas of concern—Building 1343 Outfall, Outfall Near Building 1344, Building 1345 Outfall, Asphalt Area, and Stained Area—as well as the SWMU as a whole.

Current Land Use. EPCs for surface soil ingestion and dermal contact by SWMU 23 personnel were estimated for the CTE and RME exposure scenario with data from Phase I and II RI investigations. Because the duties of on-site personnel vary, EPCs were developed for each area of concern and the SWMU as a whole to encompass all potential exposure scenarios for this receptor.

EPCs in air for on-site personnel were estimated using USEPA's SCREEN2 model. Air emissions were not evaluated for each specific area of concern. It was assumed that the SWMU, as a whole, was the main source for air emission generation for all on-site receptors. Details of the estimation of emission rates from surface soils and dispersion modeling are described in Appendix N. Table 5-143 presents the EPCs for on-site personnel at SWMU 23.

Table 5-143. Adult Exposure Point Concentrations for the Building 1343 Outfall Area Trench Area of Concern Associated with SWMU 23

Chemical	Exposure Point Concentration CTE[a]	Exposure Point Concentration RME[b]
Current Land Use		
Surface Soil (mg/kg)		
PCB 1254	0.646	0.646
Air Emissions (μg/m³)		
Anthracene	0.0000034	0.0000037
Cadmium	0.000099	0.000099
Chromium	0.0023	0.0023
Lead	0.0028	0.0028
PCBs	0.000047	0.000047
Phenanthrene	0.0000068	0.000010
Pyrene	0.000077	0.000083
Total c-PAHs[c]	0.0000058	0.0000065
Future Land Use [d]		
Surface Soil (mg/kg)		
PCB 1254	0.646	0.646
Air Emissions from Surface Soil (μg/m³)		
Anthracene	0.0000014	0.0000034
Cadmium	0.000099	0.000099
Chromium	0.0023	0.0023
Lead	0.0028	0.0028
PCBs	0.000047	0.000047
Phenanthrene	0.0000027	0.0000085
Pyrene	0.000030	0.000070
Total c-PAHs[c]	0.0000020	0.0000054
Subsurface Soil (mg/kg)		
Chromium	54.6	54.6
Air Emissions from Subsurface Soil (μg/m³)		
Chromium	0.14	0.14
Tubers/Fruits (mg/kg)		
PCB 1254	0.031	0.031
Leafy Vegetables (mg/kg)		
PCB 1254	0.00088	0.00088

[a]Central tendency exposure.
[b]Reasonable maximum exposure.
[c]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
[d]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Future Land Use. EPCs for subsurface soil ingestion and dermal contact by hypothetical future on-site construction workers at SWMU 23 were estimated using the same methods as those used for the on-site personnel under the current land use scenario (see Appendix L). However, it was assumed that the construction projects would be limited in size; therefore, potential exposure pathways are not evaluated for the SWMU as a whole but are limited to the specific areas of concern (Tables 5-143 through 5-151). EPCs for inhalation of particulates were modeled, as described in Appendix N, for the hypothetical on-site construction worker (see Appendix L).

EPCs for surface soil ingestion, dermal contact, and produce ingestion by hypothetical future on-site residents at SWMU 23 were estimated using methods described in Appendix L. The EPCs are given in Tables 5-143 through 5-151.

5.5.4.5.1 ***Estimation of Chemical Intakes***. The exposure models described in detail in Appendix L together with EPCs listed in Tables 5-143 through 5-151 were used to estimate intake for the potential exposure scenarios. Note that averaging time differs for carcinogens and noncarcinogens. Estimates of carcinogenic exposure intakes are given in Tables 5-152 through 5-185 of Section 5.5.4.6.

5.5.4.6 *Toxicity Assessment*

Information on the toxicological effects of carcinogenic and systemic toxicants are summarized in Appendix M. This toxicity assessment includes brief toxicity profiles on data listed in USEPA's IRIS database and published in HEAST (USEPA 1994). These profiles describe the acute, chronic, and carcinogenic health effects associated with SWMU-related chemicals. Toxicity values for COPCs associated with SWMU 23 are summarized in Tables 5-152 through 5-185 of the following section.

5.5.4.7 *Risk Characterization*

This section provides a characterization of the potential health risks using the intake of chemicals associated with four areas of concern associated with SWMU 23: Building 1343 Outfall, Outfall Near Building 1344, Building 1345 Outfall, and Asphalt Area and Stained Area. In addition, potential risks were evaluated for SWMU 23 as a whole. The risk characterization compares estimated potential ILCRs with reasonable levels of risk for potential carcinogens (see Section 3.1.4.1), and the estimated daily intake of systemic toxicants with appropriate reference levels. Some carcinogenic chemicals may also pose a systemic hazard, and these potential hazards are characterized as for other systemic toxicants.

Table 5-144. Child Exposure Point Concentrations for the Building 1343 Outfall Area of Concern Associated with SWMU 23

	Exposure Point Concentration	
Chemical	**CTE[(a)]**	**RME[(b)]**
Future Land Use [(c)]		
Surface Soil (mg/kg)		
PCB 1254	0.646	0.646
Air Emissions ($\mu g/m^3$)		
Anthracene	0.0000014	0.0000054
Cadmium	0.000099	0.000099
Chromium	0.0023	0.0023
Lead	0.0028	0.0028
PCBs	0.000047	0.000047
Phenanthrene	0.0000027	0.000014
Pyrene	0.000030	0.00011
Total c-PAHs[(d)]	0.0000020	0.0000088
Tubers/Fruits (mg/kg)		
PCB 1254	0.031	0.031
Leafy Vegetables (mg/kg)		
PCB 1254	0.00088	0.00088

[a]Central tendency exposure.
[b]Reasonable maximum exposure.
[c]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.
[d]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.

Table 5-145. Adult Exposure Point Concentrations for the Outfall Near Building 1344 Outfall Area of Concern Associated with SWMU 23

Chemical	Exposure Point Concentration CTE[a]	RME[b]
Current Land Use		
Surface Soil (mg/kg)		
Chromium	43.6	43.6
PCB 1254	0.098	0.098
Total c-PAHs[c]	0.051	0.057
Air Emissions ($\mu g/m^3$)		
Anthracene	0.0000034	0.0000037
Cadmium	0.000099	0.000099
Chromium	0.0023	0.0023
Lead	0.0028	0.0028
PCBs	0.000047	0.000047
Phenanthrene	0.0000068	0.000010
Pyrene	0.000077	0.000083
Total c-PAHs[c]	0.0000058	0.0000065
Future Land Use [d]		
Surface Soil (mg/kg)		
Chromium	43.6	43.6
PCB 1254	0.098	0.098
Total c-PAHs[c]	0.019	0.047
Air Emissions from Surface Soil ($\mu g/m^3$)		
Anthracene	0.0000014	0.0000034
Cadmium	0.000099	0.000099
Chromium	0.0023	0.0023
Lead	0.0028	0.0028
PCBs	0.000047	0.000047
Phenanthrene	0.0000027	0.0000085
Pyrene	0.000030	0.000070
Total c-PAHs[c]	0.0000020	0.0000054
Subsurface Soil (mg/kg)		
Chromium	537	537
Total c-PAHs[c]	0.024	0.057
Air Emissions from Subsurface Soil ($\mu g/m^3$)		
Chromium	1.41	1.41
Total c-PAHs[c]	0.000063	0.00015
Tubers/Fruits (mg/kg)		
Chromium	0.014	0.014
PCB 1254	0.0047	0.0047
Total c-PAHs[c]	0.00087	0.0022
Leafy Vegetables (mg/kg)		
Chromium	0.023	0.023
PCB 1254	0.00013	0.00013
Total c-PAHs[c]	0.000025	0.000062

[a]Central tendency exposure.
[b]Reasonable maximum exposure.
[c]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.
[d]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.

Table 5-146. Child Exposure Point Concentrations for the Outfall Near Building 1344 Area of Concern Associated with SWMU 23

Chemical	Exposure Point Concentration	
	CTE[a]	RME[b]
Future Land Use [c]		
Surface Soil (mg/kg)		
Chromium	43.6	43.6
PCB 1254	0.098	0.098
Total c-PAHs[d]	0.019	0.079
Air Emissions ($\mu g/m^3$)		
Anthracene	0.0000014	0.0000054
Cadmium	0.000099	0.000099
Chromium	0.0023	0.0023
Lead	0.0028	0.0028
PCBs	0.000047	0.000047
Phenanthrene	0.0000027	0.000014
Pyrene	0.000030	0.00011
Total c-PAHs[d]	0.0000020	0.0000088
Tubers/Fruits (mg/kg)		
Chromium	0.014	0.014
PCB 1254	0.0047	0.0047
Total c-PAHs[d]	0.00087	0.0036
Leafy Vegetables (mg/kg)		
Chromium	0.023	0.023
PCB 1254	0.00013	0.00013
Total c-PAHs[d]	0.000025	0.00010

[a]Central tendency exposure.
[b]Reasonable maximum exposure.
[c]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.
[d]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.

Table 5-147. Adult Exposure Point Concentrations for the Building 1345 Outfall Area of Concern Associated with SWMU 23

Chemical	Exposure Point Concentration	
	CTE[a]	RME[b]
Current Land Use		
Surface Soil (mg/kg)		
Cadmium	52.4	52.4
Chromium	470	470
Lead	267	267
Anthracene	0.12	0.13
Phenanthrene	0.20	0.30
Pyrene	2.46	2.64
Total PCBs[c]	34	34
Total c-PAHs[d]	0.48	0.54
Air Emissions ($\mu g/m^3$)		
Anthracene	0.0000034	0.0000037
Cadmium	0.000099	0.000099
Chromium	0.0023	0.0023
Lead	0.0028	0.0028
PCBs	0.000047	0.000047
Phenanthrene	0.0000068	0.000010
Pyrene	0.000077	0.000083
Total c-PAHs[d]	0.0000058	0.0000065
Future Land Use [e]		
Surface Soil (mg/kg)		
Cadmium	52.4	52.4
Chromium	470	470
Lead	267	267
Anthracene	0.044	0.11
Phenanthrene	0.075	0.25
Pyrene	0.95	2.24
Total PCBs[c]	34	34
Total c-PAHs[d]	0.18	0.45
Air Emissions from Surface Soil ($\mu g/m^3$)		
Anthracene	0.0000014	0.0000034
Cadmium	0.000099	0.000099
Chromium	0.0023	0.0023
Lead	0.0028	0.0028
PCBs	0.000047	0.000047
Phenanthrene	0.0000027	0.0000085
Pyrene	0.000030	0.000070
Total c-PAHs[d]	0.0000020	0.0000054
Subsurface Soil (mg/kg)		
Chromium	66.6	66.6
PCB 1248	0.16	0.16

Table 5-147. Adult Exposure Point Concentrations for the Building 1345 Outfall Area of Concern Associated with SWMU 23 (continued)

Chemical	Exposure Point Concentration	
	CTE(a)	RME(b)
Air Emissions from Subsurface Soil ($\mu g/m^3$)		
Chromium	0.17	0.17
PCB 1248	0.00042	0.00042
Tubers/Fruits (mg/kg)		
Cadmium	0.55	0.55
Chromium	0.15	0.15
Lead	0.53	0.53
Anthracene	0.027	0.067
Phenanthrene	0.045	0.15
Pyrene	0.16	0.38
Total PCBs(c)	1.6	1.6
Total c-PAHs(d)	0.0083	0.021
Leafy Vegetables (mg/kg)		
Cadmium	2.02	2.02
Chromium	0.25	0.25
Lead	0.84	0.84
Anthracene	0.00078	0.0019
Phenanthrene	0.0013	0.0043
Pyrene	0.0046	0.011
Total PCBs(c)	0.046	0.046
Total c-PAHs(d)	0.00024	0.00058

[a]Cental tendency exposure.
[b]Reasonable maximum exposure.
[c]PCB 1248 and 1254.
[d]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
[e]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Table 5-148. Child Exposure Point Concentrations for the Building 1345 Outfall Area of Concern Associated with SWMU 23

	Exposure Point Concentration	
Chemical	**CTE[a]**	**RME[b]**
Future Land Use [c]		
Surface Soil (mg/kg)		
Cadmium	52.4	52.4
Chromium	470	470
Lead	267	267
Anthracene	0.044	0.18
Phenanthrene	0.075	0.42
Pyrene	0.95	3.46
Total PCBs[d]	34	34
Total c-PAHs[e]	0.18	0.74
Air Emissions ($\mu g/m^3$)		
Anthracene	0.0000014	0.0000054
Cadmium	0.000099	0.000099
Chromium	0.0023	0.0023
Lead	0.0028	0.0028
PCBs	0.000047	0.000047
Phenanthrene	0.0000027	0.000014
Pyrene	0.000030	0.00011
Total c-PAHs[e]	0.0000020	0.0000088
Tubers/Fruits (mg/kg)		
Cadmium	0.55	0.55
Chromium	0.15	0.15
Lead	0.53	0.53
Anthracene	0.027	0.11
Phenanthrene	0.045	0.25
Pyrene	0.16	0.59
Total PCBs[d]	1.6	1.6
Total c-PAHs[e]	0.0083	0.034
Leafy Vegetables (mg/kg)		
Cadmium	2.02	2.02
Chromium	0.25	0.25
Lead	0.84	0.84
Anthracene	0.00078	0.0032
Phenanthrene	0.0013	0.0072
Pyrene	0.0046	0.017
Total PCBs[d]	0.046	0.046
Total c-PAHs[e]	0.00024	0.00097

[a]Central tendency exposure.
[b]Reasonable maximum exposure.
[c]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.
[d]PCB 1248 and 1254.
[e]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.

Table 5-149 Adult Exposure Point Concentrations for the Asphalt Area and Stained Area of Concern Associated with SWMU 23

Chemical	Exposure Point Concentration	
	CTE[a]	RME[b]
Current Land Use		
Surface Soil (mg/kg)		
Chromium	162	162
Total c-PAHs[c]	0.12	0.13
Air Emissions ($\mu g/m^3$)		
Anthracene	0.0000034	0.0000037
Cadmium	0.000099	0.000099
Chromium	0.0023	0.0023
Lead	0.0028	0.0028
PCBs	0.000047	0.000047
Phenanthrene	0.0000068	0.000010
Pyrene	0.000077	0.000083
Total c-PAHs[c]	0.0000058	0.0000065
Future Land Use [d]		
Surface Soil (mg/kg)		
Chromium	162	162
Total c-PAHs[c]	.045	.011
Air Emissions from Surface Soil ($\mu g/m^3$)		
Anthracene	0.0000014	0.0000034
Cadmium	0.000099	0.000099
Chromium	0.0023	0.0023
Lead	0.0028	0.0028
PCBs	0.000047	0.000047
Phenanthrene	0.0000027	0.0000085
Pyrene	0.000030	0.000070
Total c-PAHs[c]	0.0000020	0.0000054
Subsurface Soil (mg/kg)		
Chromium	116	116
Total c-PAHs[c]	0.049	0.12
Air Emissions from Subsurface Soil ($\mu g/m^3$)		
Chromium	0.30	0.30
Total c-PAHs[c]	0.00013	0.00031
Tubers/Fruits (mg/kg)		
Chromium	0.051	0.051
Total c-PAHs[c]	0.0021	0.0052
Leafy Vegetables (mg/kg)		
Chromium	0.085	0.085
Total c-PAHs[c]	0.000059	0.00015

[a]Central tendency exposure.
[b]Reasonable maximum exposure.
[c]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
[d]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Table 5-150. Child Exposure Point Concentrations for the Asphalt Area and Stained Area of Concern Associated with SWMU 23

	Exposure Point Concentration	
Chemical	**CTE[a]**	**RME[b]**
Future Land Use [c]		
Surface Soil (mg/kg)		
Chromium	162	162
Total c-PAHs[d]	0.045	0.19
Air Emissions ($\mu g/m^3$)		
Anthracene	0.0000014	0.0000054
Cadmium	0.000099	0.000099
Chromium	0.0023	0.0023
Lead	0.0028	0.0028
PCBs	0.000047	0.000047
Phenanthrene	0.0000027	0.000014
Pyrene	0.000030	0.00011
Total c-PAHs[d]	0.0000020	0.0000088
Tubers/Fruits (mg/kg)		
Chromium	0.051	0.051
Total c-PAHs[d]	0.0021	0.0086
Leafy Vegetables (mg/kg)		
Chromium	0.085	0.085
Total c-PAHs[d]	0.000059	0.00025

[a]Central tendency exposure.
[b]Reasonable maximum exposure.
[c]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.
[d]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.

Table 5-151. Adult Exposure Point Concentrations for SWMU 23 as a Whole

	Exposure Point Concentration	
Chemical	**CTE[(a)]**	**RME[(b)]**
Current Land Use		
Surface Soil (mg/kg)		
Anthracene	0.10	0.11
Cadmium	2.90	2.90
Chromium	67.5	67.5
Lead	82.7	82.7
PCBs	1.38	1.38
Phenanthrene	0.20	0.30
Pyrene	2.27	2.44
Total c-PAHs[(c)]	0.17	0.19
Air Emissions ($\mu g/m^3$)		
Anthracene	0.0000034	0.0000037
Cadmium	0.000099	0.000099
Chromium	0.0023	0.0023
Lead	0.0028	0.0028
PCBs	0.000047	0.000047
Phenanthrene	0.0000068	0.000010
Pyrene	0.000077	0.000083
Total c-PAHs[(c)]	0.0000058	0.0000065

[a]Central tendency exposure.
[b]Reasonable maximum exposure.
[c]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.

Table 5-152. Summary of Potential Carcinogenic Risk Results for the Current/ Future On-site Laborer for SWMU 23 (Building 1343 Outfall)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
PCB 1254	6.5E-01	6.1E-11	7.7E+00	4.7E-10	
			Pathway Total:	4.7E-10	9%
Dermal Contact with Surface Soil					
PCB 1254	6.5E-01	3.1E-11	8.1E+00	2.5E-10	
			Pathway Total:	2.5E-10	5%
Inhalation of Particulates					
Anthracene	3.4E-09	NA[e]	NA	NA	
Total PAHs[d]	5.8E-09	NA	NA	NA	
Cadmium	9.9E-08	4.5E-12	6.3E+00	2.8E-11	
Chromium	2.3E-06	1.0E-10	4.2E+01	4.4E-09	
Lead	2.8E-06	NA	NA	NA	
PCBs[f]	2.8E-08	NA	NA	NA	
Phenanthrene	6.8E-09	NA	NA	NA	
Pyrene	7.7E-08	NA	NA	NA	
			Pathway Total:	4.4E-09	86%
			Total CTE ILCR:	5.1E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
PCB 1254	6.5E-01	4.9E-08	7.7E+00	3.8E-07	
			Pathway Total:	3.8E-07	20%
Dermal Contact with Surface Soil					
PCB 1254	6.5E-01	5.7E-08	8.1E+00	4.6E-07	
			Pathway Total:	4.6E-07	24%
Inhalation of Particulates					
Anthracene	3.7E-09	NA	NA	NA	
Total PAHs	6.5E-09	NA	NA	NA	
Cadmium	9.9E-08	1.1E-09	6.3E+00	6.8E-09	
Chromium	2.3E-06	2.5E-08	4.2E+01	1.1E-06	
Lead	2.8E-06	NA	NA	NA	
PCBs[e]	4.7E-08	NA	NA	NA	
Phenanthrene	1.0E-08	NA	NA	NA	
Pyrene	8.3E-08	NA	NA	NA	
			Pathway Total:	1.1E-06	56%
			Total RME ILCR:	1.9E-06	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
[e]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.
[f]PCB 1248 and PCB 1254.

Table 5-153. Summary of Potential Carcinogenic Risk Results for the Future On-site Adult Resident for SWMU 23 (Building 1343 Outfall)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
PCB 1254	6.5E-01	5.7E-09	7.7E+00	4.4E-08	
			Pathway Total:	4.4E-08	0%
Dermal Contact with Surface Soil					
PCB 1254	6.5E-01	2.8E-09	8.1E+00	2.3E-08	
			Pathway Total:	2.3E-08	0%
Inhalation of Particulates					
Anthracene	1.4E-09	NA[d]	NA	NA	
Total PAHs[e]	2.0E-09	NA	NA	NA	
Cadmium	9.9E-08	3.6E-10	6.3E+00	2.3E-09	
Chromium	2.3E-06	8.3E-09	4.2E+01	3.5E-07	
Lead	2.8E-06	NA	NA	NA	
PCBs[f]	4.7E-08	NA	NA	NA	
Phenanthrene	2.7E-09	NA	NA	NA	
Pyrene	3.0E-08	NA	NA	NA	
			Pathway Total:	3.5E-07	3%
Ingestion of Leafy Vegetables					
PCB 1254	8.8E-04	1.3E-08	7.7E+00	1.0E-07	
			Pathway Total:	1.0E-07	1%
Ingestion of Tubers and Fruits					
PCB 1254	3.1E-02	1.6E-06	7.7E+00	1.2E-05	
			Pathway Total:	1.2E-05	96%
			Total CTE ILCR:	1.2E-05	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
PCB 1254	6.5E-01	1.3E-07	7.7E+00	1.0E-06	
			Pathway Total:	1.0E-06	1%
Dermal Contact with Surface Soil					
PCB 1254	6.5E-01	1.6E-07	8.1E+00	1.3E-06	
			Pathway Total:	1.3E-06	1%
Inhalation of Particulates					
Anthracene	3.4E-09	NA	NA	NA	
Total PAHs	5.4E-09	NA	NA	NA	
Cadmium	9.9E-08	1.9E-09	6.3E+00	1.2E-08	
Chromium	2.3E-06	4.4E-08	4.2E+01	1.8E-06	
Lead	2.8E-06	NA	NA	NA	
PCBs[f]	4.7E-08	NA	NA	NA	
Phenanthrene	8.5E-09	NA	NA	NA	
Pyrene	7.0E-08	NA	NA	NA	
			Pathway Total:	1.9E-06	1%
Ingestion of Leafy Vegetables					
PCB 1254	8.8E-04	1.7E-07	7.7E+00	1.3E-06	
			Pathway Total:	1.3E-06	1%
Ingestion of Tubers and Fruits					
PCB 1254	3.1E-02	2.0E-05	7.7E+00	1.6E-04	
			Pathway Total:	1.6E-04	97%
			Total RME ILCR:	1.6E-04	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.
[e]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
[f]PCB 1248 and PCB 1254.

Table 5-154. Summary of Potential Carcinogenic Risk Results for the Future On-site Child Resident for SWMU 23 (Building 1343 Outfall)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
PCB 1254	6.5E-01	2.6E-08	7.7E+00	2.0E-07	
			Pathway Total:	2.0E-07	1%
Dermal Contact with Surface Soil					
PCB 1254	6.5E-01	4.8E-09	8.1E+00	3.9E-08	
			Pathway Total:	3.9E-08	0%
Inhalation of Particulates					
Anthracene	1.4E-09	NA[d]	NA	NA	
Total PAHs[e]	2.0E-09	NA	NA	NA	
Cadmium	9.9E-08	1.8E-09	6.3E+00	1.2E-08	
Chromium	2.3E-06	4.3E-08	4.2E+01	1.8E-06	
Lead	2.8E-06	NA	NA	NA	
PCBs[f]	4.7E-08	NA	NA	NA	
Phenanthrene	2.7E-09	NA	NA	NA	
Pyrene	3.0E-08	NA	NA	NA	
			Pathway Total:	1.8E-06	8%
Ingestion of Leafy Vegetables					
PCB 1254	8.8E-04	2.1E-08	7.7E+00	1.6E-07	
			Pathway Total:	1.6E-07	1%
Ingestion of Tubers and Fruits					
PCB 1254	3.1E-02	2.5E-06	7.7E+00	1.9E-05	
			Pathway Total:	1.9E-05	90%
			Total CTE ILCR:	2.2E-05	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
PCB 1254	6.5E-01	2.9E-07	7.7E+00	2.2E-06	
			Pathway Total:	2.2E-06	2%
Dermal Contact with Surface Soil					
PCB 1254	6.5E-01	6.5E-08	8.1E+00	5.3E-07	
			Pathway Total:	5.3E-07	0%
Inhalation of Particulates					
Anthracene	5.4E-09	NA	NA	NA	
Total PAHs	8.8E-09	NA	NA	NA	
Cadmium	9.9E-08	3.0E-09	6.3E+00	1.9E-08	
Chromium	2.3E-06	6.9E-08	4.2E+01	2.9E-06	
Lead	2.8E-06	NA	NA	NA	
PCBs[f]	4.7E-08	NA	NA	NA	
Phenanthrene	1.4E-08	NA	NA	NA	
Pyrene	1.1E-07	NA	NA	NA	
			Pathway Total:	2.9E-06	3%
Ingestion of Leafy Vegetables					
PCB 1254	8.8E-04	1.1E-07	7.7E+00	8.7E-07	
			Pathway Total:	8.7E-07	1%
Ingestion of Tubers and Fruits					
PCB 1254	3.1E-02	1.3E-05	7.7E+00	1.0E-04	
			Pathway Total:	1.0E-04	94%
			Total RME ILCR:	1.1E-04	100%

[a] Units for the inhalation pathway are mg/m^3.

[b] See Appendix L for sources and methodology on estimating a daily intake value.

[c] See Appendix M for sources and methodology of toxicity values.

[d] NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

[e] Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.

[f] PCB 1248 and PCB 1254.

Table 5-155. Summary of Potential Carcinogenic Risk Results for the Future Construction Worker for SWMU 23 (Building 1343 Outfall)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Subsurface Soil					
Chromium	5.5E+01	NA[d]	NA	NA	
			Pathway Total:	NA	NA
Dermal Contact with Subsurface Soil					
Chromium	5.5E+01	NA	NA	NA	
			Pathway Total:	NA	NA
Inhalation of Particulates					
Chromium	1.4E-04	1.4E-08	4.2E+01	5.8E-07	
			Pathway Total:	5.8E-07	100%
			Total CTE ILCR:	5.8E-07	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Subsurface Soil					
Chromium	5.5E+01	NA	NA	NA	
			Pathway Total:	NA	NA
Dermal Contact with Subsurface Soil					
Chromium	5.5E+01	NA	NA	NA	
			Pathway Total:	NA	NA
Inhalation of Particulates					
Chromium	1.4E-04	1.8E-07	4.2E+01	7.7E-06	
			Pathway Total:	7.7E-06	100%
			Total RME ILCR:	7.7E-06	100%

[a] Units for the inhalation pathway are mg/m^3.
[b] See Appendix L for sources and methodology on estimating a daily intake value.
[c] See Appendix M for sources and methodology of toxicity values.
[d] NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-156. Summary of Potential Carcinogenic Risk Results for the Current/Future On-site Laborer for SWMU 23 (Outfall Near Building 1344)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] (mg/kg-day)$^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Chromium	4.4E+01	NA[d]	NA	NA	
PCB 1254	9.8E-02	9.3E-12	7.7E+00	7.2E-11	
Total PAHs[e]	5.1E-02	4.9E-12	7.3E+00	3.5E-11	
			Pathway Total:	1.1E-10	2%
Dermal Contact with Surface Soil					
Chromium	4.4E+01	NA	NA	NA	
PCB 1254	9.8E-02	4.7E-12	8.1E+00	3.8E-11	
Total PAHs	5.1E-02	2.4E-12	1.5E+01	3.5E-11	
			Pathway Total:	7.3E-11	2%
Inhalation of Particulates					
Anthracene	3.4E-09	NA	NA	NA	
Total PAHs	5.8E-09	NA	NA	NA	
Cadmium	9.9E-08	4.5E-12	6.3E+00	2.8E-11	
Chromium	2.3E-06	1.0E-10	4.2E+01	4.4E-09	
Lead	2.8E-06	NA	NA	NA	
PCBs[f]	4.7E-08	NA	NA	NA	
Phenanthrene	6.8E-09	NA	NA	NA	
Pyrene	7.7E-08	NA	NA	NA	
			Pathway Total:	4.4E-09	96%
			Total CTE ILCR:	4.6E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Chromium	4.4E+01	NA	NA	NA	
PCB 1254	9.8E-02	7.5E-09	7.7E+00	5.7E-08	
Total PAHs	5.7E-02	4.3E-09	7.3E+00	3.2E-08	
			Pathway Total:	8.9E-08	7%
Dermal Contact with Surface Soil					
Chromium	4.4E+01	NA	NA	NA	
PCB 1254	9.8E-02	8.7E-09	8.1E+00	7.0E-08	
Total PAHs	5.7E-02	5.0E-09	1.5E+01	7.4E-08	
			Pathway Total:	1.4E-07	11%
Inhalation of Particulates					
Anthracene	3.7E-09	NA	NA	NA	
Total PAHs	6.5E-09	NA	NA	NA	
Cadmium	9.9E-08	1.1E-09	6.3E+00	6.8E-09	
Chromium	2.3E-06	2.5E-08	4.2E+01	1.1E-06	
Lead	2.8E-06	NA	NA	NA	
PCBs[f]	4.7E-08	NA	NA	NA	
Phenanthrene	1.0E-08	NA	NA	NA	
Pyrene	8.3E-08	NA	NA	NA	
			Pathway Total:	1.1E-06	82%
			Total RME ILCR:	1.3E-06	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.
[e]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
[f]PCB 1248 and PCB 1254.

Table 5-157. Summary of Potential Carcinogenic Risk Results for the Future On-site Adult Resident for SWMU 23 (Outfall Near Building (1344)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) (mg/kg-day)-1	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Chromium	4.4E+01	NA(d)	NA	NA	
PCB 1254	9.8E-02	8.6E-10	7.7E+00	6.6E-09	
Total PAHs(e)	1.9E-02	1.7E-10	7.3E+00	1.2E-09	
			Pathway Total:	7.8E-09	0%
Dermal Contact with Surface Soil					
Chromium	4.4E+01	NA	NA	NA	
PCB 1254	9.8E-02	4.3E-10	8.1E+00	3.5E-09	
Total PAHs	1.9E-02	8.3E-11	1.5E+01	1.2E-09	
			Pathway Total:	4.7E-09	0%
Inhalation of Particulates					
Anthracene	1.4E-09	NA	NA	NA	
Total PAHs	2.0E-09	NA	NA	NA	
Cadmium	9.9E-08	3.6E-10	6.3E+00	2.3E-09	
Chromium	2.3E-06	8.3E-09	4.2E+01	3.5E-07	
Lead	2.8E-06	NA	NA	NA	
PCBs(f)	4.7E-08	NA	NA	NA	
Phenanthrene	2.7E-09	NA	NA	NA	
Pyrene	3.0E-08	NA	NA	NA	
			Pathway Total:	3.5E-07	14%
Ingestion of Leafy Vegetables					
Chromium	2.3E-02	NA	NA	NA	
PCB 1254	1.3E-04	1.9E-09	7.7E+00	1.5E-08	
Total PAHs	2.5E-05	3.7E-10	7.3E+00	2.7E-09	
			Pathway Total:	1.8E-08	1%
Ingestion of Tubers and Fruits					
Chromium	1.4E-02	NA	NA	NA	
PCB 1254	4.7E-03	2.4E-07	7.7E+00	1.8E-06	
Total PAHs	8.7E-04	4.4E-08	7.3E+00	3.2E-07	
			Pathway Total:	2.1E-06	85%
			Total CTE ILCR:	2.5E-06	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Chromium	4.4E+01	NA	NA	NA	
PCB 1254	9.8E-02	2.0E-08	7.7E+00	1.6E-07	
Total PAHs	4.7E-02	9.8E-09	7.3E+00	7.1E-08	
			Pathway Total:	2.3E-07	1%
Dermal Contact with Surface Soil					
Chromium	4.4E+01	NA	NA	NA	
PCB 1254	9.8E-02	2.4E-08	8.1E+00	1.9E-07	
Total PAHs	4.7E-02	1.1E-08	1.5E+01	1.7E-07	
			Pathway Total:	3.6E-07	1%
Inhalation of Particulates					
Anthracene	3.4E-09	NA	NA	NA	
Total PAHs	5.4E-09	NA	NA	NA	
Cadmium	9.9E-08	1.9E-09	6.3E+00	1.2E-08	
Chromium	2.3E-06	4.4E-08	4.2E+01	1.8E-06	
Lead	2.8E-06	NA	NA	NA	
Total PAHs	4.7E-08	NA	NA	NA	
Phenanthrene	8.5E-09	NA	NA	NA	
Pyrene	7.0E-08	NA	NA	NA	
			Pathway Total:	1.9E-06	5%
Ingestion of Leafy Vegetables					
Chromium	2.3E-02	NA	NA	NA	
PCB 1254	1.3E-04	2.5E-08	7.7E+00	2.0E-07	
Total PAHs	6.2E-05	1.2E-08	7.3E+00	8.8E-08	
			Pathway Total:	2.8E-07	1%
Ingestion of Tubers and Fruits					
Chromium	1.4E-02	NA	NA	NA	
PCB 1254	4.7E-03	3.1E-06	7.7E+00	2.4E-05	
Total PAHs	2.2E-03	1.4E-06	7.3E+00	1.0E-05	
			Pathway Total:	3.4E-05	93%
			Total RME ILCR:	3.7E-05	100%

(a) Units for the inhalation pathway are mg/m^3.
(b) See Appendix L for sources and methodology on estimating a daily intake value.
(c) See Appendix M for sources and methodology of toxicity values.
(d) NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.
(e) Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
(f) PCB 1248 and PCB 1254.

Table 5-158. Summary of Potential Carcinogenic Risk Results for the Future On-site Child Resident for SWMU 23 (Outfall Near Building 1344)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) (mg/kg-day)-1	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Chromium	4.4E+01	NA(d)	NA	NA	
PCB 1254	9.8E-02	3.9E-09	7.7E+00	3.0E-08	
Total PAHs(e)	1.9E-02	7.5E-10	7.3E+00	5.5E-09	
			Pathway Total:	3.5E-08	1%
Dermal Contact with Surface Soil					
Chromium	4.4E+01	NA	NA	NA	
PCB 1254	9.8E-02	7.2E-10	8.1E+00	5.9E-09	
Total PAHs	1.9E-02	1.4E-10	1.5E+01	2.0E-09	
			Pathway Total:	7.9E-09	0%
Inhalation of Particulates					
Anthracene	1.4E-09	NA	NA	NA	
Total PAHs	2.0E-09	NA	NA	NA	
Cadmium	9.9E-08	1.8E-09	6.3E+00	1.2E-08	
Chromium	2.3E-06	4.3E-08	4.2E+01	1.8E-06	
Lead	2.8E-06	NA	NA	NA	
PCBs(f)	4.7E-08	NA	NA	NA	
Phenanthrene	2.7E-09	NA	NA	NA	
Pyrene	3.0E-08	NA	NA	NA	
			Pathway Total:	1.8E-06	34%
Ingestion of Leafy Vegetables					
Chromium	2.3E-02	NA	NA	NA	
PCB 1254	1.3E-04	3.2E-09	7.7E+00	2.4E-08	
Total PAHs	2.5E-05	6.1E-10	7.3E+00	4.4E-09	
			Pathway Total:	2.9E-08	1%
Ingestion of Tubers and Fruits					
Chromium	1.4E-02	NA	NA	NA	
PCB 1254	4.7E-03	3.8E-07	7.7E+00	2.9E-06	
Total PAHs	8.7E-04	7.1E-08	7.3E+00	5.2E-07	
			Pathway Total:	3.5E-06	65%
			Total CTE ILCR:	5.3E-06	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Chromium	4.4E+01	NA	NA	NA	
PCB 1254	9.8E-02	4.3E-08	7.7E+00	3.3E-07	
Total PAHs	7.9E-02	3.5E-08	7.3E+00	2.6E-07	
			Pathway Total:	5.9E-07	2%
Dermal Contact with Surface Soil					
Chromium	4.4E+01	NA	NA	NA	
PCB 1254	9.8E-02	9.9E-09	8.1E+00	8.0E-08	
Total PAHs	7.9E-02	8.0E-09	1.5E+01	1.2E-07	
			Pathway Total:	2.0E-07	1%
Inhalation of Particulates					
Anthracene	5.4E-09	NA	NA	NA	
Total PAHs	8.8E-09	NA	NA	NA	
Cadmium	9.9E-08	3.0E-09	6.3E+00	1.9E-08	
Chromium	2.3E-06	6.9E-08	4.2E+01	2.9E-06	
Lead	2.8E-06	NA	NA	NA	
PCBs(e)	4.7E-08	NA	NA	NA	
Phenanthrene	1.4E-08	NA	NA	NA	
Pyrene	1.1E-07	NA	NA	NA	
			Pathway Total:	2.9E-06	9%
Ingestion of Leafy Vegetables					
Chromium	2.3E-02	NA	NA	NA	
PCB 1254	1.3E-04	1.7E-08	7.7E+00	1.3E-07	
Total PAHs	1.0E-04	1.3E-08	7.3E+00	9.7E-08	
			Pathway Total:	2.3E-07	1%
Ingestion of Tubers and Fruits					
Chromium	1.4E-02	NA	NA	NA	
PCB 1254	4.7E-03	2.0E-06	7.7E+00	1.6E-05	
Total PAHs	3.6E-03	1.6E-06	7.3E+00	1.1E-05	
			Pathway Total:	2.7E-05	87%
			Total RME ILCR:	3.1E-05	100%

aUnits for the inhalation pathway are mg/m^3.
bSee Appendix L for sources and methodology on estimating a daily intake value.
cSee Appendix M for sources and methodology of toxicity values.
dNA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.
eBenzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
fPCB 1248 and PCB 1254.

Table 5-159. Summary of Potential Carcinogenic Risk Results for the Future Construction Worker for SWMU 23 (Outfall Near Building 1344)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) (mg/kg-day)-1	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Subsurface Soil					
Chromium	5.4E+02	NA[d]	NA	NA	
Total PAHs[e]	2.4E-02	1.8E-10	7.3E+00	1.3E-09	
			Pathway Total:	1.3E-09	0%
Dermal Contact with Subsurface Soil					
Chromium	5.4E+02	NA	NA	NA	
Total PAHs	2.4E-02	6.2E-12	1.5E+01	9.1E-11	
			Pathway Total:	9.1E-11	0%
Inhalation of Particulates					
Chromium	1.4E-03	1.4E-07	4.2E+01	5.8E-06	
Total PAHs	6.3E-08	NA	NA	NA	
			Pathway Total:	5.8E-06	100%
			Total CTE ILCR:	5.8E-06	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Subsurface Soil					
Chromium	5.4E+02	NA	NA	NA	
Total PAHs	5.7E-02	5.8E-09	7.3E+00	4.2E-08	
			Pathway Total:	4.2E-08	0%
Dermal Contact with Subsurface Soil					
Chromium	5.4E+02	NA	NA	NA	
Total PAHs	5.7E-02	1.0E-09	1.5E+01	1.5E-08	
			Pathway Total:	1.5E-08	0%
Inhalation of Particulates					
Chromium	1.4E-03	1.8E-06	4.2E+01	7.6E-05	
Total PAHs	1.5E-07	NA	NA	NA	
			Pathway Total:	7.6E-05	100%
			Total RME ILCR:	7.6E-05	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.
[e]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.

Table 5-160. Summary of Potential Carcinogenic Risk Results for the Current/Future On-site Laborer for SWMU 23 (Building 1345 Outfall)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) (mg/kg-day)-1	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Anthracene	1.2E-01	NA(d)	NA	NA	
Cadmium	5.2E+01	NA	NA	NA	
Chromium	4.7E+02	NA	NA	NA	
Lead	2.7E+02	NA	NA	NA	
Total PCBs(e)	3.4E+01	3.2E-09	7.7E+00	2.5E-08	
Phenanthrene	2.0E-01	NA	NA	NA	
Pyrene	2.5E+00	NA	NA	NA	
Total PAHs	4.8E-01	4.6E-11	7.3E+00	3.3E-10	
			Pathway Total:	2.5E-08	59%
Dermal Contact with Surface Soil					
Anthracene	1.2E-01	NA	NA	NA	
Cadmium	5.2E+01	NA	NA	NA	
Chromium	4.7E+02	NA	NA	NA	
Lead	2.7E+02	NA	NA	NA	
Total PCBs	3.4E+01	1.6E-09	8.1E+00	1.3E-08	
Phenanthrene	2.0E-01	NA	NA	NA	
Pyrene	2.5E+00	NA	NA	NA	
Total PAHs	4.8E-01	2.3E-11	1.5E+01	3.3E-10	
			Pathway Total:	1.3E-08	31%
Inhalation of Particulates					
Anthracene	3.4E-09	NA	NA	NA	
Total PAHs	5.8E-09	NA	NA	NA	
Cadmium	9.9E-08	4.5E-12	6.3E+00	2.8E-11	
Chromium	2.3E-06	1.0E-10	4.2E+01	4.4E-09	
Lead	2.8E-06	NA	NA	NA	
PCBs(f)	4.7E-08	NA	NA	NA	
Phenanthrene	6.8E-09	NA	NA	NA	
Pyrene	7.7E-08	NA	NA	NA	
			Pathway Total:	4.4E-09	10%
			Total CTE ILCR:	4.3E-08	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Anthracene	1.3E-01	NA	NA	NA	
Cadmium	5.2E+01	NA	NA	NA	
Chromium	4.7E+02	NA	NA	NA	
Lead	2.7E+02	NA	NA	NA	
Total PCBs	3.4E+01	2.6E-06	7.7E+00	2.0E-05	
Phenanthrene	3.0E-01	NA	NA	NA	
Pyrene	2.6E+00	NA	NA	NA	
Total PAHs	5.4E-01	4.1E-08	7.3E+00	3.0E-07	
			Pathway Total:	2.0E-05	44%
Dermal Contact with Surface Soil					
Anthracene	1.3E-01	NA	NA	NA	
Cadmium	5.2E+01	NA	NA	NA	
Chromium	4.7E+02	NA	NA	NA	
Lead	2.7E+02	NA	NA	NA	
Total PCBs	3.4E+01	3.0E-06	8.1E+00	2.4E-05	
Phenanthrene	3.0E-01	NA	NA	NA	
Pyrene	2.6E+00	NA	NA	NA	
Total PAHs	5.4E-01	4.7E-08	1.5E+01	6.9E-07	
			Pathway Total:	2.5E-05	54%
Inhalation of Particulates					
Anthracene	3.7E-09	NA	NA	NA	
Total PAHs	6.5E-09	NA	NA	NA	
Cadmium	9.9E-08	1.1E-09	6.3E+00	6.8E-09	
Chromium	2.3E-06	2.5E-08	4.2E+01	1.1E-06	
Lead	2.8E-06	NA	NA	NA	
Total PCBs	4.7E-08	NA	NA	NA	
Phenanthrene	1.0E-08	NA	NA	NA	
Pyrene	8.3E-08	NA	NA	NA	
			Pathway Total:	1.1E-06	2%
			Total RME ILCR:	4.6E-05	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.
[e]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
[f]PCB 1248 and PCB 1254.

Table 5-161. Summary of Potential Carcinogenic Risk Results for the Future On-site Adult Resident for SWMU 23 (Building 1345 Outfall)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) (mg/kg-day)$^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Anthracene	4.4E-02	NA(d)	NA	NA	
Cadmium	5.2E+01	NA	NA	NA	
Chromium	4.7E+02	NA	NA	NA	
Lead	2.7E+02	NA	NA	NA	
PCBs(e)	3.4E+01	3.0E-07	7.7E+00	2.3E-06	
Phenanthrene	7.5E-02	NA	NA	NA	
Pyrene	9.5E-01	NA	NA	NA	
Total PAHs(f)	1.8E-01	1.6E-09	7.3E+00	1.2E-08	
			Pathway Total:	2.3E-06	0%
Dermal Contact with Surface Soil					
Anthracene	4.4E-02	NA	NA	NA	
Cadmium	5.2E+01	NA	NA	NA	
Chromium	4.7E+02	NA	NA	NA	
Lead	2.7E+02	NA	NA	NA	
PCBs	3.4E+01	1.5E-07	8.1E+00	1.2E-06	
Phenanthrene	7.5E-02	NA	NA	NA	
Pyrene	9.5E-01	NA	NA	NA	
Total PAHs	1.8E-01	7.9E-10	1.5E+01	1.2E-08	
			Pathway Total:	1.2E-06	0%
Inhalation of Particulates					
Anthracene	1.4E-09	NA	NA	NA	
Total PAHs	2.0E-09	NA	NA	NA	
Cadmium	9.9E-08	3.6E-10	6.3E+00	2.3E-09	
Chromium	2.3E-06	8.3E-09	4.2E+01	3.5E-07	
Lead	2.8E-06	NA	NA	NA	
PCBs	4.7E-08	NA	NA	NA	
Phenanthrene	2.7E-09	NA	NA	NA	
Pyrene	3.0E-08	NA	NA	NA	
			Pathway Total:	3.5E-07	0%
Ingestion of Leafy Vegetables					
Anthracene	7.8E-04	NA	NA	NA	
Cadmium	2.0E+00	NA	NA	NA	
Chromium	2.5E-01	NA	NA	NA	
Lead	1.0E+00	NA	NA	NA	
PCBs	4.6E-02	6.9E-07	7.7E+00	5.3E-06	
Phenanthrene	1.3E-03	NA	NA	NA	
Pyrene	4.6E-03	NA	NA	NA	
Total PAHs	2.4E-04	3.5E-09	7.3E+00	2.6E-08	
			Pathway Total:	5.3E-06	1%
Ingestion of Tubers and Fruits					
Anthracene	2.7E-02	NA	NA	NA	
Cadmium	5.5E-01	NA	NA	NA	
Chromium	1.5E-01	NA	NA	NA	
Lead	1.0E+00	NA	NA	NA	
PCBs	1.6E+00	8.0E-05	7.7E+00	6.2E-04	
Phenanthrene	4.5E-02	NA	NA	NA	
Pyrene	1.6E-01	NA	NA	NA	
Total PAHs	8.3E-03	4.1E-07	7.3E+00	3.0E-06	
			Pathway Total:	6.2E-04	99%
			Total CTE ILCR:	6.3E-04	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Anthracene	1.1E-01	NA	NA	NA	
Cadmium	5.2E+01	NA	NA	NA	
Chromium	4.7E+02	NA	NA	NA	
Lead	2.7E+02	NA	NA	NA	
PCBs	3.4E+01	7.1E-06	7.7E+00	5.4E-05	
Phenanthrene	2.5E-01	NA	NA	NA	
Pyrene	2.2E+00	NA	NA	NA	
Total PAHs	4.5E-01	9.3E-08	7.3E+00	6.8E-07	
			Pathway Total:	5.5E-05	1%
Dermal Contact with Surface Soil					
Anthracene	1.1E-01	NA	NA	NA	
Cadmium	5.2E+01	NA	NA	NA	
Chromium	4.7E+02	NA	NA	NA	
Lead	2.7E+02	NA	NA	NA	
PCBs	3.4E+01	8.2E-06	8.1E+00	6.7E-05	
Phenanthrene	2.5E-01	NA	NA	NA	
Pyrene	2.2E+00	NA	NA	NA	
Total PAHs	4.5E-01	1.1E-07	1.5E+01	1.6E-06	
			Pathway Total:	6.8E-05	1%

Table 5-161. Summary of Potential Carcinogenic Risk Results for the Future On-site Adult Resident for SWMU 23 (Building 1345 Outfall) (continued)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) (mg/kg-day)$^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Inhalation of Particulates					
Anthracene	3.4E-09	NA	NA	NA	
Total PAHs	5.4E-09	NA	NA	NA	
Cadmium	9.9E-08	1.9E-09	6.3E+00	1.2E-08	
Chromium	2.3E-06	4.4E-08	4.2E+01	1.8E-06	
Lead	2.8E-06	NA	NA	NA	
PCBs	4.6E-02	NA	NA	NA	
Phenanthrene	8.5E-09	NA	NA	NA	
Pyrene	7.0E-08	NA	NA	NA	
			Pathway Total:	1.9E-06	0%
Ingestion of Leafy Vegetables					
Anthracene	1.9E-03	NA	NA	NA	
Cadmium	2.0E+00	NA	NA	NA	
Chromium	2.5E-01	NA	NA	NA	
Lead	1.0E+00	NA	NA	NA	
PCBs	4.6E-02	9.0E-06	7.7E+00	6.9E-05	
Phenanthrene	4.3E-03	NA	NA	NA	
Pyrene	1.1E-02	NA	NA	NA	
Total PAHs	5.8E-04	1.1E-07	7.3E+00	8.4E-07	
			Pathway Total:	7.0E-05	1%
Ingestion of Tubers and Fruits					
Anthracene	6.7E-02	NA	NA	NA	
Cadmium	5.5E-01	NA	NA	NA	
Chromium	1.5E-01	NA	NA	NA	
Lead	1.0E+00	NA	NA	NA	
PCBs	1.6E+00	1.1E-03	7.7E+00	8.1E-03	
Phenanthrene	1.5E-01	NA	NA	NA	
Pyrene	3.8E-01	NA	NA	NA	
Total PAHs	2.1E-02	1.3E-05	7.3E+00	9.8E-05	
			Pathway Total:	8.2E-03	98%
			Total RME ILCR:	8.4E-03	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.
[e]PCB 1248 and PCB 1254.
[f]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.

Table 5-162. Summary of Potential Carcinogenic Risk Results for the Future On-site Child Resident for SWMU 23 (Building 1345 Outfall)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) (mg/kg-day)-1	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Anthracene	4.4E-02	NA(d)	NA	NA	
Cadmium	5.2E+01	NA	NA	NA	
Chromium	4.7E+02	NA	NA	NA	
Lead	2.7E+02	NA	NA	NA	
PCBs(e)	3.4E+01	1.3E-06	7.7E+00	1.0E-05	
Phenanthrene	7.5E-02	NA	NA	NA	
Pyrene	9.5E-01	NA	NA	NA	
Total PAHs(f)	1.8E-01	7.1E-09	7.3E+00	5.2E-08	
			Pathway Total:	1.0E-05	1%
Dermal Contact with Surface Soil					
Anthracene	4.4E-02	NA	NA	NA	
Cadmium	5.2E+01	NA	NA	NA	
Chromium	4.7E+02	NA	NA	NA	
Lead	2.7E+02	NA	NA	NA	
PCBs	3.4E+01	2.5E-07	8.1E+00	2.0E-06	
Phenanthrene	7.5E-02	NA	NA	NA	
Pyrene	9.5E-01	NA	NA	NA	
Total PAHs	1.8E-01	1.3E-09	1.5E+01	1.9E-08	
			Pathway Total:	2.1E-06	0%
Inhalation of Particulates					
Anthracene	1.4E-09	NA	NA	NA	
Total PAHs	2.0E-09	NA	NA	NA	
Cadmium	9.9E-08	1.8E-09	6.3E+00	1.2E-08	
Chromium	2.3E-06	4.3E-08	4.2E+01	1.8E-06	
Lead	2.8E-06	NA	NA	NA	
PCBs	4.7E-08	NA	NA	NA	
Phenanthrene	2.7E-09	NA	NA	NA	
Pyrene	3.0E-08	NA	NA	NA	
			Pathway Total:	1.8E-06	0%
Ingestion of Leafy Vegetables					
Anthracene	7.8E-04	NA	NA	NA	
Cadmium	2.0E+00	NA	NA	NA	
Chromium	2.5E-01	NA	NA	NA	
Lead	1.0E+00	NA	NA	NA	
PCBs	4.6E-02	1.1E-06	7.7E+00	8.6E-06	
Phenanthrene	1.3E-03	NA	NA	NA	
Pyrene	4.6E-03	NA	NA	NA	
Total PAHs	2.4E-04	5.7E-09	7.3E+00	4.2E-08	
			Pathway Total:	8.6E-06	1%
Ingestion of Tubers and Fruits					
Anthracene	2.7E-02	NA	NA	NA	
Cadmium	5.5E-01	NA	NA	NA	
Chromium	1.5E-01	NA	NA	NA	
Lead	1.0E+00	NA	NA	NA	
PCBs	1.6E+00	1.3E-04	7.7E+00	1.0E-03	
Phenanthrene	4.5E-02	NA	NA	NA	
Pyrene	1.6E-01	NA	NA	NA	
Total PAHs	8.3E-03	6.7E-07	7.3E+00	4.9E-06	
			Pathway Total:	1.0E-03	98%
			Total CTE ILCR:	1.0E-03	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Anthracene	1.8E-01	NA	NA	NA	
Cadmium	5.2E+01	NA	NA	NA	
Chromium	4.7E+02	NA	NA	NA	
Lead	2.7E+02	NA	NA	NA	
PCBs	3.4E+01	1.5E-05	7.7E+00	1.2E-04	
Phenanthrene	4.2E-01	NA	NA	NA	
Pyrene	3.5E+00	NA	NA	NA	
Total PAHs	7.5E-01	3.3E-07	7.3E+00	2.4E-06	
			Pathway Total:	1.2E-04	2%
Dermal Contact with Surface Soil					
Anthracene	1.8E-01	NA	NA	NA	
Cadmium	5.2E+01	NA	NA	NA	
Chromium	4.7E+02	NA	NA	NA	
Lead	2.7E+02	NA	NA	NA	
PCBs	3.4E+01	3.4E-06	8.1E+00	2.8E-05	
Phenanthrene	4.2E-01	NA	NA	NA	
Pyrene	3.5E+00	NA	NA	NA	
Total PAHs	7.5E-01	7.5E-08	1.5E+01	1.1E-06	
			Pathway Total:	2.9E-05	1%

Table 5-162. Summary of Potential Carcinogenic Risk Results for the Future On-site Child Resident for SWMU 23 (Building 1345 Outfall) (continued)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Inhalation of Particulates					
Anthracene	5.4E-09	NA	NA	NA	
Total PAHs	8.8E-09	NA	NA	NA	
Cadmium	9.9E-08	3.0E-09	6.3E+00	1.9E-08	
Chromium	2.3E-06	6.9E-08	4.2E+01	2.9E-06	
Lead	2.8E-06	NA	NA	NA	
PCBs	4.7E-08	NA	NA	NA	
Phenanthrene	1.4E-08	NA	NA	NA	
Pyrene	1.1E-07	NA	NA	NA	
			Pathway Total:	2.9E-06	0%
Ingestion of Leafy Vegetables					
Anthracene	3.2E-03	4.1E-07	NA	NA	
Cadmium	2.0E+00	2.6E-04	NA	NA	
Chromium	2.5E-01	3.2E-05	NA	NA	
Lead	1.0E+00	1.3E-04	NA	NA	
PCBs	4.6E-02	5.9E-06	7.7E+00	4.6E-05	
Phenanthrene	7.2E-03	9.3E-07	NA	NA	
Pyrene	1.7E-02	2.2E-06	NA	NA	
Total PAHs	9.7E-04	1.3E-07	7.3E+00	9.2E-07	
			Pathway Total:	4.7E-05	1%
Ingestion of Tubers and Fruits					
Anthracene	1.1E-01	NA	NA	NA	
Cadmium	5.5E-01	NA	NA	NA	
Chromium	1.5E-01	NA	NA	NA	
Lead	1.0E+00	NA	NA	NA	
PCBs	1.6E+00	6.9E-04	7.7E+00	5.3E-03	
Phenanthrene	2.5E-01	NA	NA	NA	
Pyrene	5.9E-01	NA	NA	NA	
Total PAHs	3.4E-02	1.5E-05	7.3E+00	1.1E-04	
			Pathway Total:	5.4E-03	97%
			Total RME ILCR:	5.6E-03	100%

(a) Units for the inhalation pathway are mg/m^3.

(b) See Appendix L for sources and methodology on estimating a daily intake value.

(c) See Appendix M for sources and methodology of toxicity values.

(d) NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

(e) PCB 1248 and PCB 1254.

(f) Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.

Table 5-163. Summary of Potential Carcinogenic Risk Results for the Future Construction Worker for SWMU 23 (Building 1345 Outfall)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) (mg/kg-day)$^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Subsurface Soil					
Chromium	6.7E+01	NA(d)	NA	NA	
PCB 1248	1.6E-01	1.1E-09	7.7E+00	8.7E-09	
			Pathway Total:	8.7E-09	1%
Dermal Contact with Subsurface Soil					
Chromium	6.7E+01	NA	NA	NA	
PCB 1248	1.6E-01	4.0E-11	8.1E+00	3.3E-10	
			Pathway Total:	3.3E-10	0%
Inhalation of Particulates					
Chromium	1.7E-04	1.7E-08	4.2E+01	7.1E-07	
PCB 1248	4.2E-07	NA	NA	NA	
			Pathway Total:	7.1E-07	99%
			Total CTE ILCR:	7.2E-07	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Subsurface Soil					
Chromium	6.7E+01	NA	NA	NA	
PCB 1248	1.6E-01	1.6E-08	7.7E+00	1.2E-07	
			Pathway Total:	1.2E-07	1%
Dermal Contact with Subsurface Soil					
Chromium	6.7E+01	NA	NA	NA	
PCB 1248	1.6E-01	2.8E-09	8.1E+00	2.3E-08	
			Pathway Total:	2.3E-08	0%
Inhalation of Particulates					
Chromium	1.7E-04	2.2E-07	4.2E+01	9.4E-06	
PCB 1248	4.2E-07	NA	NA	NA	
			Pathway Total:	9.4E-06	98%
			Total RME ILCR:	9.5E-06	100%

[a] Units for the inhalation pathway are mg/m^3.

[b] See Appendix L for sources and methodology on estimating a daily intake value.

[c] See Appendix M for sources and methodology of toxicity values.

[d] NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 5-164. Summary of Potential Carcinogenic Risk Results for the Current On-site Laborer for SWMU 23 (Asphalt and Stained Areas)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Chromium	1.6E+02	NA[d]	NA	NA	
Total PAHs[e]	1.2E-01	1.1E-11	7.3E+00	8.3E-11	
			Pathway Total:	8.3E-11	2%
Dermal Contact with Surface Soil					
Chromium	1.6E+02	NA	NA	NA	
Total PAHs	1.2E-01	5.7E-12	1.5E+01	8.3E-11	
			Pathway Total:	8.3E-11	2%
Inhalation of Particulates					
Anthracene	3.4E-09	NA	NA	NA	
Total PAHs	5.8E-09	NA	NA	NA	
Cadmium	9.9E-08	4.5E-12	6.3E+00	2.8E-11	
Chromium	2.3E-06	1.0E-10	4.2E+01	4.4E-09	
Lead	2.8E-06	NA	NA	NA	
PCBs[f]	4.7E-08	NA	NA	NA	
Phenanthrene	6.8E-09	NA	NA	NA	
Pyrene	7.7E-08	NA	NA	NA	
			Pathway Total:	4.4E-09	96%
			Total CTE ILCR:	4.6E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Chromium	1.6E+02	NA	NA	NA	
Total PAHs	1.3E-01	9.9E-09	7.3E+00	7.2E-08	
			Pathway Total:	7.2E-08	6%
Dermal Contact with Surface Soil					
Chromium	1.6E+02	NA	NA	NA	
Total PAHs	1.3E-01	1.2E-08	1.5E+01	1.7E-07	
			Pathway Total:	1.7E-07	13%
Inhalation of Particulates					
Anthracene	3.7E-09	NA	NA	NA	
Total PAHs	6.5E-09	NA	NA	NA	
Cadmium	9.9E-08	1.1E-09	6.3E+00	6.8E-09	
Chromium	2.3E-06	2.5E-08	4.2E+01	1.1E-06	
Lead	2.8E-06	NA	NA	NA	
PCBs	4.7E-08	NA	NA	NA	
Phenanthrene	1.0E-08	NA	NA	NA	
Pyrene	8.3E-08	NA	NA	NA	
			Pathway Total:	1.1E-06	82%
			Total RME ILCR:	1.3E-06	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.
[e]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
[f]PCB 1248 and PCB 1254.

Table 5-165. Summary of Potential Carcinogenic Risk Results for the Future On-site Adult Resident for SWMU 23 (Asphalt and Stained Areas)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) (mg/kg-day)-1	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Chromium	1.6E+02	NA[d]	NA	NA	
Total PAHs[e]	4.5E-02	3.9E-10	7.3E+00	2.9E-09	
			Pathway Total:	2.9E-09	0%
Dermal Contact with Surface Soil					
Chromium	1.6E+02	NA	NA	NA	
Total PAHs	4.5E-02	2.0E-10	1.5E+01	3.0E-09	
			Pathway Total:	3.0E-09	0%
Inhalation of Particulates					
Anthracene	1.4E-09	NA	NA	NA	
Total PAHs	2.0E-09	NA	NA	NA	
Cadmium	9.9E-08	3.6E-10	6.3E+00	2.3E-09	
Chromium	2.3E-06	8.3E-09	4.2E+01	3.5E-07	
Lead	2.8E-06	NA	NA	NA	
PCBs[f]	4.7E-08	NA	NA	NA	
Phenanthrene	2.7E-09	NA	NA	NA	
Pyrene	3.0E-08	NA	NA	NA	
			Pathway Total:	3.5E-07	31%
Ingestion of Leafy Vegetables					
Chromium	8.5E-02	NA	NA	NA	
Total PAHs	5.9E-05	8.8E-10	7.3E+00	6.4E-09	
			Pathway Total:	6.4E-09	1%
Ingestion of Tubers and Fruits					
Chromium	5.1E-02	NA	NA	NA	
Total PAHs	2.1E-03	1.0E-07	7.3E+00	7.6E-07	
			Pathway Total:	7.6E-07	68%
			Total CTE ILCR:	1.1E-06	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Chromium	1.6E+02	NA	NA	NA	
Total PAHs	1.1E-01	2.3E-08	7.3E+00	1.7E-07	
			Pathway Total:	1.7E-07	1%
Dermal Contact with Surface Soil					
Chromium	1.6E+02	NA	NA	NA	
Total PAHs	1.1E-01	2.7E-08	1.5E+01	4.0E-07	
			Pathway Total:	4.0E-07	1%
Inhalation of Particulates					
Anthracene	3.4E-09	NA	NA	NA	
Total PAHs	5.4E-09	NA	NA	NA	
Cadmium	9.9E-08	1.9E-09	6.3E+00	1.2E-08	
Chromium	2.3E-06	4.4E-08	4.2E+01	1.8E-06	
Lead	2.8E-06	NA	NA	NA	
PCBs	4.7E-08	NA	NA	NA	
Phenanthrene	8.5E-09	NA	NA	NA	
Pyrene	7.0E-08	NA	NA	NA	
			Pathway Total:	1.9E-06	7%
Ingestion of Leafy Vegetables					
Chromium	8.5E-02	NA	NA	NA	
Total PAHs	1.5E-04	2.9E-08	7.3E+00	3.9E-09	
			Pathway Total:	3.9E-09	0%
Ingestion of Tubers and Fruits					
Chromium	5.1E-02	NA	NA	NA	
Total PAHs	5.2E-03	3.4E-06	7.3E+00	2.5E-05	
			Pathway Total:	2.5E-05	91%
			Total RME ILCR:	2.7E-05	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.
[e]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
[f]PCB 1248 and PCB 1254.

Table 5-166. Summary of Potential Carcinogenic Risk Results for the Future On-site Child Resident for SWMU 23 (Asphalt and Stained Areas)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Chromium	1.6E+02	NA(d)	NA	NA	
Total PAHs(e)	4.5E-02	1.8E-09	7.3E+00	1.3E-08	
			Pathway Total:	1.3E-08	0%
Dermal Contact with Surface Soil					
Chromium	1.6E+02	NA	NA	NA	
Total PAHs	4.5E-02	3.3E-10	1.5E+01	4.8E-09	
			Pathway Total:	4.8E-09	0%
Inhalation of Particulates					
Anthracene	1.4E-09	NA	NA	NA	
Total PAHs	2.0E-09	NA	NA	NA	
Cadmium	9.9E-08	1.8E-09	6.3E+00	1.2E-08	
Chromium	2.3E-06	4.3E-08	4.2E+01	1.8E-06	
Lead	2.8E-06	NA	NA	NA	
PCBs(f)	4.7E-08	NA	NA	NA	
Phenanthrene	2.7E-09	NA	NA	NA	
Pyrene	3.0E-08	NA	NA	NA	
			Pathway Total:	1.8E-06	59%
Ingestion of Leafy Vegetables					
Chromium	8.5E-02	NA	NA	NA	
Total PAHs	5.9E-05	1.4E-09	7.3E+00	1.0E-08	
			Pathway Total:	1.0E-08	0%
Ingestion of Tubers and Fruits					
Chromium	5.1E-02	NA	NA	NA	
Total PAHs	2.1E-03	1.7E-07	7.3E+00	1.2E-06	
			Pathway Total:	1.2E-06	40%
			Total CTE ILCR:	3.1E-06	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Chromium	1.6E+02	NA	NA	NA	
Total PAHs	1.9E-01	8.3E-08	7.3E+00	6.0E-07	
			Pathway Total:	6.0E-07	2%
Dermal Contact with Surface Soil					
Chromium	1.6E+02	NA	NA	NA	
Total PAHs	1.9E-01	1.9E-08	1.5E+01	2.8E-07	
			Pathway Total:	2.8E-07	1%
Inhalation of Particulates					
Anthracene	5.4E-09	NA	NA	NA	
Total PAHs	8.8E-09	NA	NA	NA	
Cadmium	9.9E-08	3.0E-09	6.3E+00	1.9E-08	
Chromium	2.3E-06	6.9E-08	4.2E+01	2.9E-06	
Lead	2.8E-06	NA	NA	NA	
PCBs	4.7E-08	NA	NA	NA	
Phenanthrene	1.4E-08	NA	NA	NA	
Pyrene	1.1E-07	NA	NA	NA	
			Pathway Total:	2.9E-06	9%
Ingestion of Leafy Vegetables					
Chromium	8.5E-02	NA	NA	NA	
Total PAHs	2.5E-04	3.2E-08	7.3E+00	2.3E-07	
			Pathway Total:	2.3E-07	1%
Ingestion of Tubers and Fruits					
Chromium	5.1E-02	NA	NA	NA	
Total PAHs	8.6E-03	3.7E-06	7.3E+00	2.7E-05	
			Pathway Total:	2.7E-05	87%
			Total RME ILCR:	3.1E-05	100%

aUnits for the inhalation pathway are mg/m^3.
bSee Appendix L for sources and methodology on estimating a daily intake value.
cSee Appendix M for sources and methodology of toxicity values.
dNA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.
eBenzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
fPCB 1248 and PCB 1254.

Table 5-167. Summary of Potential Carcinogenic Risk Results for the Future Construction Worker for SWMU 23 (Asphalt and Stained Areas)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Subsurface Soil					
Chromium	1.2E+02	NA(d)	NA	NA	
Total PAHs(e)	4.9E-02	3.6E-10	7.3E+00	2.6E-09	
			Pathway Total:	2.6E-09	0%
Dermal Contact with Subsurface Soil					
Chromium	1.2E+02	NA	NA	NA	
Total PAHs	4.9E-02	1.3E-11	1.5E+01	1.9E-10	
			Pathway Total:	1.9E-10	0%
Inhalation of Particulates					
Chromium	3.0E-04	3.0E-08	4.2E+01	1.2E-06	
Total PAHs	1.3E-07	NA	NA	NA	
			Pathway Total:	1.2E-06	100%
			Total CTE ILCR:	1.2E-06	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Subsurface Soil					
Chromium	1.2E+02	NA	NA	NA	
Total PAHs	1.2E-01	1.2E-08	7.3E+00	8.6E-08	
			Pathway Total:	8.6E-08	1%
Dermal Contact with Subsurface Soil					
Chromium	1.2E+02	NA	NA	NA	
Total PAHs	1.2E-01	2.1E-09	1.5E+01	3.1E-08	
			Pathway Total:	3.1E-08	0%
Inhalation of Particulates					
Chromium	3.0E-04	3.9E-07	4.2E+01	1.6E-05	
Total PAHs	3.1E-07	NA	NA	NA	
			Pathway Total:	1.6E-05	99%
			Total RME ILCR:	1.6E-05	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

[e]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.

Table 5-168. Summary of Potential Carcinogenic Risk Results for the Current/Future On-site Laborer for SWMU 23 as a Whole

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] (mg/kg-day)$^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Anthracene	1.0E-01	NA[d]	NA	NA	
Cadmium	2.9E+00	NA	NA	NA	
Chromium	6.8E+01	NA	NA	NA	
Lead	8.7E+01	NA	NA	NA	
PCBs[e]	1.4E+00	1.3E-10	7.7E+00	1.0E-09	
Phenanthrene	2.0E-01	NA	NA	NA	
Pyrene	2.3E+00	NA	NA	NA	
Total PAHs[f]	1.7E-01	1.6E-11	7.3E+00	1.2E-10	
			Pathway Total:	1.1E-09	18%
Dermal Contact with Surface Soil					
Anthracene	1.0E-01	NA	NA	NA	
Cadmium	2.9E+00	NA	NA	NA	
Chromium	6.8E+01	NA	NA	NA	
Lead	8.7E+01	NA	NA	NA	
PCBs	1.4E+00	6.6E-11	8.1E+00	5.3E-10	
Phenanthrene	2.0E-01	NA	NA	NA	
Pyrene	2.3E+00	NA	NA	NA	
Total PAHs	1.7E-01	8.1E-12	1.5E+01	1.2E-10	
			Pathway Total:	6.5E-10	10%
Inhalation of Particulates					
Anthracene	3.4E-09	NA	NA	NA	
Total PAHs	5.8E-09	NA	NA	NA	
Cadmium	9.9E-08	4.5E-12	6.3E+00	2.8E-11	
Chromium	2.3E-06	1.0E-10	4.2E+01	4.4E-09	
Lead	2.8E-06	NA	NA	NA	
PCBs	4.7E-08	NA	NA	NA	
Phenanthrene	6.8E-09	NA	NA	NA	
Pyrene	7.7E-08	NA	NA	NA	
			Pathway Total:	4.4E-09	71%
			Total CTE ILCR:	6.2E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Anthracene	1.1E-01	NA	NA	NA	
Cadmium	2.9E+00	NA	NA	NA	
Chromium	6.8E+01	NA	NA	NA	
Lead	8.7E+01	NA	NA	NA	
PCBs	1.4E+00	1.1E-07	7.7E+00	8.1E-07	
Phenanthrene	3.0E-01	NA	NA	NA	
Pyrene	2.4E+00	NA	NA	NA	
Total PAHs	1.9E-01	1.4E-08	7.3E+00	1.1E-07	
			Pathway Total:	9.1E-07	28%
Dermal Contact with Surface Soil					
Anthracene	1.1E-01	NA	NA	NA	
Cadmium	2.9E+00	NA	NA	NA	
Chromium	6.8E+01	NA	NA	NA	
Lead	8.7E+01	NA	NA	NA	
PCBs	1.4E+00	1.2E-07	8.1E+00	9.9E-07	
Phenanthrene	3.0E-01	NA	NA	NA	
Pyrene	2.4E+00	NA	NA	NA	
Total PAHs	1.9E-01	1.7E-08	1.5E+01	2.5E-07	
			Pathway Total:	1.2E-06	38%
Inhalation of Particulates					
Anthracene	3.7E-09	NA	NA	NA	
Total PAHs	6.5E-09	NA	NA	NA	
Cadmium	9.9E-08	1.1E-09	6.3E+00	6.8E-09	
Chromium	2.3E-06	2.5E-08	4.2E+01	1.1E-06	
Lead	2.8E-06	NA	NA	NA	
PCBs	4.7E-08	NA	NA	NA	
Phenanthrene	1.0E-08	NA	NA	NA	
Pyrene	8.3E-08	NA	NA	NA	
			Pathway Total:	1.1E-06	33%
			Total RME ILCR:	3.2E-06	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.
[e]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
[f]PCB 1248 and PCB 1254.

Table 5-169. Summary of Potential Systemic Effects for the Current/Future On-site Laborer for SWMU 23 (Building 1343 Outfall)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
PCB 1254	6.5E-01	1.5E-09	2.0E-05	7.7E-05	
			Pathway Total:	7.7E-05	66%
Dermal Contact with Surface Soil					
PCB 1254	6.5E-01	7.7E-10	1.9E-05	4.0E-05	
			Pathway Total:	4.0E-05	34%
Inhalation of Particulates					
Anthracene	3.4E-09	NA(d)	NA	NA	
Total PAHs(e)	5.8E-09	NA	NA	NA	
Cadmium	9.9E-08	NA	NA	NA	
Chromium	2.3E-06	NA	NA	NA	
Lead	2.8E-06	NA	NA	NA	
PCBs(f)	4.7E-08	NA	NA	NA	
Phenanthrene	6.8E-09	NA	NA	NA	
Pyrene	7.7E-08	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	1.2E-04	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
PCB 1254	6.5E-01	1.5E-07	2.0E-05	7.4E-03	
			Pathway Total:	7.4E-03	45%
Dermal Contact with Surface Soil					
PCB 1254	6.5E-01	1.7E-07	1.9E-05	9.0E-03	
			Pathway Total:	9.0E-03	55%
Inhalation of Particulates					
Anthracene	3.7E-09	NA	NA	NA	
Total PAHs	6.5E-09	NA	NA	NA	
Cadmium	9.9E-08	NA	NA	NA	
Chromium	2.3E-06	NA	NA	NA	
Lead	2.8E-06	NA	NA	NA	
PCBs	4.7E-08	NA	NA	NA	
Phenanthrene	1.0E-08	NA	NA	NA	
Pyrene	8.3E-08	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	1.6E-02	100%

[a] Units for the inhalation pathway are mg/m^3.
[b] See Appendix L for sources and methodology on estimating a daily intake value.
[c] See Appendix M for sources and methodology of toxicity values.
[d] NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.
[e] Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
[f] PCB 1248 and PCB 1254.

Table 5-170. Summary of Potential Systemic Effects for the Future On-site Adult Resident for SWMU 23 (Building 1343 Outfall)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
PCB 1254	6.5E-01	5.3E-08	2.0E-05	2.7E-03	
			Pathway Total:	2.7E-03	0%
Dermal Contact with Surface Soil					
PCB 1254	6.5E-01	2.7E-08	1.9E-05	1.4E-03	
			Pathway Total:	1.4E-03	0%
Inhalation of Particulates					
Anthracene	1.4E-09	NA[d]	NA	NA	
Total PAHs[e]	2.0E-09	NA	NA	NA	
Cadmium	9.9E-08	NA	NA	NA	
Chromium	2.3E-06	NA	NA	NA	
Lead	2.8E-06	NA	NA	NA	
PCBs[f]	4.7E-08	NA	NA	NA	
Phenanthrene	2.7E-09	NA	NA	NA	
Pyrene	3.0E-08	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
PCB 1254	8.8E-04	1.2E-07	2.0E-05	6.2E-03	
			Pathway Total:	6.2E-03	1%
Ingestion of Tubers and Fruits					
PCB 1254	3.1E-02	1.5E-05	2.0E-05	7.3E-01	
			Pathway Total:	7.3E-01	99%
			Total CTE HI:	7.4E-01	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
PCB 1254	6.5E-01	3.4E-07	2.0E-05	1.7E-02	
			Pathway Total:	1.7E-02	1%
Dermal Contact with Surface Soil					
PCB 1254	6.5E-01	3.9E-07	1.9E-05	2.1E-02	
			Pathway Total:	2.1E-02	1%
Inhalation of Particulates					
Anthracene	3.4E-09	NA	NA	NA	
Total PAHs	5.4E-09	NA	NA	NA	
Cadmium	9.9E-08	NA	NA	NA	
Chromium	2.3E-06	NA	NA	NA	
Lead	2.8E-06	NA	NA	NA	
PCBs	4.7E-08	NA	NA	NA	
Phenanthrene	8.5E-09	NA	NA	NA	
Pyrene	7.0E-08	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
PCB 1254	8.8E-04	4.3E-07	2.0E-05	2.2E-02	
			Pathway Total:	2.2E-02	1%
Ingestion of Tubers and Fruits					
PCB 1254	3.1E-02	5.1E-05	2.0E-05	2.6E+00	
			Pathway Total:	2.6E+00	98%
			Total RME HI:	2.6E+00	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

[e]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.

[f]PCB 1248 and PCB 1254.

Table 5-171. Summary of Potential Systemic Effects for the Current/Future On-site Child Resident for SWMU 23 (Building 1343 Outfall)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
PCB 1254	6.5E-01	2.4E-07	2.0E-05	1.2E-02	
			Pathway Total:	1.2E-02	1%
Dermal Contact with Surface Soil					
PCB 1254	6.5E-01	4.5E-08	1.9E-05	2.4E-03	
			Pathway Total:	2.4E-03	0%
Inhalation of Particulates					
Anthracene	1.4E-09	NA[d]	NA	NA	
Total PAHs[e]	2.0E-09	NA	NA	NA	
Cadmium	9.9E-08	NA	NA	NA	
Chromium	2.3E-06	NA	NA	NA	
Lead	2.8E-06	NA	NA	NA	
PCBs[f]	4.7E-08	NA	NA	NA	
Phenanthrene	2.7E-09	NA	NA	NA	
Pyrene	3.0E-08	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
PCB 1254	8.8E-04	2.0E-07	2.0E-05	1.0E-02	
			Pathway Total:	1.0E-02	1%
Ingestion of Tubers and Fruits					
PCB 1254	3.1E-02	2.4E-05	2.0E-05	1.2E+00	
			Pathway Total:	1.2E+00	98%
			Total CTE HI:	1.2E+00	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
PCB 1254	6.5E-01	1.2E-06	2.0E-05	6.0E-02	
			Pathway Total:	6.0E-02	2%
Dermal Contact with Surface Soil					
PCB 1254	6.5E-01	2.7E-07	1.9E-05	1.4E-02	
			Pathway Total:	1.4E-02	0%
Inhalation of Particulates					
Anthracene	5.4E-09	NA	NA	NA	
Total PAHs	8.8E-09	NA	NA	NA	
Cadmium	9.9E-08	NA	NA	NA	
Chromium	2.3E-06	NA	NA	NA	
Lead	2.8E-06	NA	NA	NA	
PCBs	4.7E-08	NA	NA	NA	
Phenanthrene	1.4E-08	NA	NA	NA	
Pyrene	1.1E-07	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
PCB 1254	8.8E-04	4.7E-07	2.0E-05	2.4E-02	
			Pathway Total:	2.4E-02	1%
Ingestion of Tubers and Fruits					
PCB 1254	3.1E-02	5.6E-05	2.0E-05	2.8E+00	
			Pathway Total:	2.8E+00	97%
			Total RME HI:	2.9E+00	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.
[e]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
[f]PCB 1248 and PCB 1254.

Table 5-172. Summary of Potential Systemic Effects for the Future Construction Worker for SWMU 23 (Building 1343 Outfall)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Subsurface Soil					
Chromium	5.5E+01	3.0E-05	2.0E-02	1.5E-03	
			Pathway Total:	1.5E-03	100%
Dermal Contact with Subsurface Soil					
Chromium	5.5E+01	1.1E-07	1.0E-01	1.1E-06	
			Pathway Total:	1.1E-06	0%
Inhalation of Particulates					
Chromium	1.4E-04	NA[d]	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	1.5E-03	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Subsurface Soil					
Chromium	5.5E+01	1.4E-04	2.0E-02	7.0E-03	
			Pathway Total:	7.0E-03	100%
Dermal Contact with Subsurface Soil					
Chromium	5.5E+01	2.5E-06	1.0E-01	2.5E-05	
			Pathway Total:	2.5E-05	0%
Inhalation of Particulates					
Chromium	1.4E-04	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	7.1E-03	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-173. Summary of Potential Systemic Effects for the Current/Future On-site Laborer for SWMU 23 (Outfall Near Building 1344)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Chromium	4.4E+01	1.0E-07	2.0E-02	5.2E-06	
PCB 1254	9.8E-02	2.3E-10	2.0E-05	1.2E-05	
Total PAHs[d]	5.1E-02	NA[e]	NA	NA	
			Pathway Total:	1.7E-05	73%
Dermal Contact with Surface Soil					
Chromium	4.4E+01	5.2E-09	1.0E-01	5.2E-08	
PCB 1254	9.8E-02	1.2E-10	1.9E-05	6.1E-06	
Total PAHs	5.1E-02	NA	NA	NA	
			Pathway Total:	6.2E-06	27%
Inhalation of Particulates					
Anthracene	3.4E-09	NA	NA	NA	
Total PAHs	5.8E-09	NA	NA	NA	
Cadmium	9.9E-08	NA	NA	NA	
Chromium	2.3E-06	NA	NA	NA	
Lead	2.8E-06	NA	NA	NA	
PCBs[f]	4.7E-08	NA	NA	NA	
Phenanthrene	6.8E-09	NA	NA	NA	
Pyrene	7.7E-08	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	2.3E-05	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Chromium	4.4E+01	9.9E-06	5.0E-03	2.0E-03	
PCB 1254	9.8E-02	2.2E-08	2.0E-05	1.1E-03	
Total PAHs	5.7E-02	NA	NA	NA	
			Pathway Total:	3.1E-03	34%
Dermal Contact with Surface Soil					
Chromium	4.4E+01	1.2E-06	2.5E-04	4.6E-03	
PCB 1254	9.8E-02	2.6E-08	1.9E-05	1.4E-03	
Total PAHs	5.7E-02	NA	NA	NA	
			Pathway Total:	6.0E-03	66%
Inhalation of Particulates					
Anthracene	3.7E-09	NA	NA	NA	
Total PAHs	6.5E-09	NA	NA	NA	
Cadmium	9.9E-08	NA	NA	NA	
Chromium	2.3E-06	NA	NA	NA	
Lead	2.8E-06	NA	NA	NA	
PCBs	4.7E-08	NA	NA	NA	
Phenanthrene	1.0E-08	NA	NA	NA	
Pyrene	8.3E-08	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	9.1E-03	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
[e]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.
[f]PCB 1248 and PCB 1254.

Table 5-174. Summary of Potential Systemic Effects for the Future On-Site Adult Resident for SWMU 23 (Outfall Near Building 1344)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Chromium	4.4E+01	3.6E-06	5.0E-03	7.2E-04	
PCB 1254	9.8E-02	8.1E-09	2.0E-05	4.0E-04	
Total PAHs[d]	1.9E-02	NA[e]	NA	NA	
			Pathway Total:	1.1E-03	1%
Dermal Contact with Surface Soil					
Chromium	4.4E+01	1.8E-07	2.5E-04	7.2E-04	
PCB 1254	9.8E-02	4.0E-09	1.9E-05	2.1E-04	
Total PAHs	1.9E-02	NA	NA	NA	
			Pathway Total:	9.3E-04	1%
Inhalation of Particulates					
Anthracene	1.4E-09	NA	NA	NA	
Total PAHs	2.0E-09	NA	NA	NA	
Cadmium	9.9E-08	NA	NA	NA	
Chromium	2.3E-06	NA	NA	NA	
Lead	2.8E-06	NA	NA	NA	
PCBs[f]	4.7E-08	NA	NA	NA	
Phenanthrene	2.7E-09	NA	NA	NA	
Pyrene	3.0E-08	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Chromium	2.3E-02	3.2E-06	5.0E-03	6.4E-04	
PCB 1254	1.3E-04	1.8E-08	2.0E-05	9.1E-04	
Total PAHs	2.5E-05	NA	NA	NA	
			Pathway Total:	1.6E-03	1%
Ingestion of Tubers and Fruits					
Chromium	1.4E-02	6.4E-06	5.0E-03	1.3E-03	
PCB 1254	4.7E-03	2.2E-06	2.0E-05	1.1E-01	
Total PAHs	8.7E-04	NA	NA	NA	
			Pathway Total:	1.1E-01	97%
			Total CTE HI:	1.2E-01	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Chromium	4.4E+01	2.3E-05	5.0E-03	4.5E-03	
PCB 1254	9.8E-02	5.1E-08	2.0E-05	2.5E-03	
Total PAHs	4.7E-02	NA	NA	NA	
			Pathway Total:	7.1E-03	2%
Dermal Contact with Surface Soil					
Chromium	4.4E+01	2.6E-06	2.5E-04	1.1E-02	
PCB 1254	9.8E-02	5.9E-08	1.9E-05	3.1E-03	
Total PAHs	4.7E-02	NA	NA	NA	
			Pathway Total:	1.4E-02	3%
Inhalation of Particulates					
Anthracene	3.4E-09	NA	NA	NA	
Total PAHs	5.4E-09	NA	NA	NA	
Cadmium	9.9E-08	NA	NA	NA	
Chromium	2.3E-06	NA	NA	NA	
Lead	2.8E-06	NA	NA	NA	
PCBs	4.7E-08	NA	NA	NA	
Phenanthrene	8.5E-09	NA	NA	NA	
Pyrene	7.0E-08	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Chromium	2.3E-02	1.1E-05	5.0E-03	2.2E-03	
PCB 1254	1.3E-04	6.4E-08	2.0E-05	3.2E-03	
Total PAHs	6.2E-05	NA	NA	NA	
			Pathway Total:	[illegible].4E-03	1%
Ingestion of Tubers and Fruits					
Chromium	1.4E-02	2.3E-05	5.0E-03	4.5E-03	
PCB 1254	4.7E-03	7.8E-06	2.0E-05	3.9E-01	
Total PAHs	2.2E-03	NA	NA	NA	
			Pathway Total:	3.9E-01	94%
			Total RME HI:	4.2E-01	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
[e]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.
[f]PCB 1248 and PCB 1254.

Table 5-175. Summary of Potential Systemic Effects for the Future On-site Child Resident for SWMU 23 (Outfall Near Building 1344)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Chromium	4.4E+01	1.6E-05	5.0E-03	3.2E-03	
PCB 1254	9.8E-02	3.6E-08	2.0E-05	1.8E-03	
Total PAHs[d]	1.9E-02	NA[e]	NA	NA	
			Pathway Total:	5.1E-03	3%
Dermal Contact with Surface Soil					
Chromium	4.4E+01	3.0E-07	2.5E-04	1.2E-03	
PCB 1254	9.8E-02	6.8E-09	1.9E-05	3.6E-04	
Total PAHs	1.9E-02	NA	NA	NA	
			Pathway Total:	1.6E-03	1%
Inhalation of Particulates					
Anthracene	1.4E-09	NA	NA	NA	
Total PAHs	2.0E-09	NA	NA	NA	
Cadmium	9.9E-08	NA	NA	NA	
Chromium	2.3E-06	NA	NA	NA	
Lead	2.8E-06	NA	NA	NA	
PCBs[f]	4.7E-08	NA	NA	NA	
Phenanthrene	2.7E-09	NA	NA	NA	
Pyrene	3.0E-08	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Chromium	2.3E-02	5.2E-06	5.0E-03	1.0E-03	
PCB 1254	1.3E-04	3.0E-08	2.0E-05	1.5E-03	
Total PAHs	2.5E-05	NA	NA	NA	
			Pathway Total:	2.5E-03	1%
Ingestion of Tubers and Fruits					
Chromium	1.4E-02	1.0E-05	5.0E-03	2.1E-03	
PCB 1254	4.7E-03	3.6E-06	2.0E-05	1.8E-01	
Total PAHs	8.7E-04	NA	NA	NA	
			Pathway Total:	1.8E-01	95%
			Total CTE HI:	1.9E-01	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Chromium	4.4E+01	8.1E-05	5.0E-03	1.6E-02	
PCB 1254	9.8E-02	1.8E-07	2.0E-05	9.1E-03	
Total PAHs	7.9E-02	NA	NA	NA	
			Pathway Total:	2.5E-02	5%
Dermal Contact with Surface Soil					
Chromium	4.4E+01	1.8E-06	2.5E-04	7.4E-03	
PCB 1254	9.8E-02	4.1E-08	1.9E-05	2.2E-03	
Total PAHs	7.9E-02	NA	NA	NA	
			Pathway Total:	9.5E-03	2%
Inhalation of Particulates					
Anthracene	5.4E-09	NA	NA	NA	
Total PAHs	8.8E-09	NA	NA	NA	
Cadmium	9.9E-08	NA	NA	NA	
Chromium	2.3E-06	NA	NA	NA	
Lead	2.8E-06	NA	NA	NA	
PCBs[f]	4.7E-08	NA	NA	NA	
Phenanthrene	1.4E-08	NA	NA	NA	
Pyrene	1.1E-07	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Chromium	2.3E-02	1.2E-05	5.0E-03	2.5E-03	
PCB 1254	1.3E-04	7.0E-08	2.0E-05	3.5E-03	
Total PAHs	1.0E-04	NA	NA	NA	
			Pathway Total:	5.9E-03	1%
Ingestion of Tubers and Fruits					
Chromium	1.4E-02	2.5E-05	5.0E-03	5.0E-03	
PCB 1254	4.7E-03	8.5E-06	2.0E-05	4.2E-01	
Total PAHs	3.6E-03	NA	NA	NA	
			Pathway Total:	4.3E-01	91%
			Total RME HI:	4.7E-01	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
[e]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.
[f]PCB 1248 and PCB 1254.

Table 5-176. Summary of Potential Systemic Effects for the Future Construction Worker for SWMU 23 (Outfall Near Building 1344)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Subsurface Soil					
Chromium	5.4E+02	2.9E-04	2.0E-02	1.5E-02	
Total PAHs(d)	8.6E-02	NA(e)	NA	NA	
			Pathway Total:	1.5E-02	93%
Dermal Contact with Subsurface Soil					
Chromium	5.4E+02	1.0E-06	1.0E-03	1.0E-03	
Total PAHs	8.6E-02	NA	NA	NA	
			Pathway Total:	1.0E-03	7%
Inhalation of Particulates					
Chromium	1.4E-03	NA	NA	NA	
Total PAHs	6.3E-08	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	1.6E-02	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Subsurface Soil					
Chromium	5.4E+02	1.4E-03	2.0E-02	6.9E-02	
Total PAHs	5.7E-02	NA	NA	NA	
			Pathway Total:	6.9E-02	74%
Dermal Contact with Subsurface Soil					
Chromium	5.4E+02	2.4E-05	1.0E-03	2.4E-02	
Total PAHs	5.7E-02	NA	NA	NA	
			Pathway Total:	2.4E-02	26%
Inhalation of Particulates					
Chromium	1.4E-03	NA	NA	NA	
Total PAHs	1.5E-07	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	9.3E-02	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.

[e]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-177. Summary of Potential Systemic Effects for the Current/Future On-site Laborer for SWMU 23 (Building 1345 Outfall)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Anthracene	1.2E-01	2.9E-10	3.0E+00	9.5E-11	
Cadmium	5.2E+01	1.2E-07	1.0E-03	1.2E-04	
Chromium	4.7E+02	1.1E-06	2.0E-02	5.6E-05	
Lead	2.7E+02	NA(d)	NA	NA	
Total PCBs(e)	3.4E+01	8.1E-08	2.0E-05	4.0E-03	
Phenanthrene	2.0E-01	NA	NA	NA	
Pyrene	2.5E+00	5.9E-09	3.0E-01	2.0E-08	
Total PAHs(f)	4.8E-01	NA	NA	NA	
			Pathway Total:	4.2E-03	65%
Dermal Contact with Surface Soil					
Anthracene	1.2E-01	1.4E-10	2.1E+00	6.8E-11	
Cadmium	5.2E+01	6.2E-09	6.0E-05	1.0E-04	
Chromium	4.7E+02	5.6E-08	1.0E-02	5.6E-06	
Lead	2.7E+02	NA	NA	NA	
Total PCBs	3.4E+01	4.0E-08	1.9E-05	2.1E-03	
Phenanthrene	2.0E-01	NA	NA	NA	
Pyrene	2.5E+00	2.9E-09	1.5E-01	2.0E-08	
Total PAHs	4.8E-01	NA	NA	NA	
			Pathway Total:	2.2E-03	35%
Inhalation of Particulates					
Anthracene	3.4E-09	NA	NA	NA	
Total PAHs	5.8E-09	NA	NA	NA	
Cadmium	9.9E-08	NA	NA	NA	
Chromium	2.3E-06	NA	NA	NA	
Lead	2.8E-06	NA	NA	NA	
PCBs(g)	4.7E-08	NA	NA	NA	
Phenanthrene	6.8E-09	NA	NA	NA	
Pyrene	7.7E-08	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	6.5E-03	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Anthracene	8.7E-01	2.0E-07	3.0E-01	6.6E-07	
Cadmium	5.2E+01	1.2E-05	1.0E-03	1.2E-02	
Chromium	4.7E+02	1.1E-04	5.0E-03	2.1E-02	
Lead	2.7E+02	NA	NA	NA	
Total PCBs	3.4E+01	7.8E-06	2.0E-05	3.9E-01	
Phenanthrene	2.4E+00	NA	NA	NA	
Pyrene	7.5E+00	1.7E-06	3.0E-02	5.7E-05	
Total PAHs	3.4E+00	NA	NA	NA	
			Pathway Total:	4.2E-01	43%
Dermal Contact with Surface Soil					
Anthracene	8.7E-01	2.3E-07	2.1E-01	1.1E-06	
Cadmium	5.2E+01	1.4E-06	6.0E-05	2.3E-02	
Chromium	4.7E+02	1.2E-05	2.5E-04	5.0E-02	
Lead	2.7E+02	NA	NA	NA	
Total PCBs	3.4E+01	9.0E-06	1.9E-05	4.7E-01	
Phenanthrene	2.4E+00	NA	NA	NA	
Pyrene	7.5E+00	2.0E-06	1.5E-02	1.3E-04	
Total PAHs	3.4E+00	NA	NA	NA	
			Pathway Total:	5.5E-01	57%
Inhalation of Particulates					
Anthracene	3.7E-09	NA	NA	NA	
Cadmium	6.5E-09	NA	NA	NA	
Chromium	9.9E-08	NA	NA	NA	
Lead	2.3E-06	NA	NA	NA	
Total PCBs	2.8E-06	NA	NA	NA	
Phenanthrene	4.7E-08	NA	NA	NA	
Pyrene	1.0E-08	NA	NA	NA	
Total PAHs	8.3E-08	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	9.7E-01	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.
[e]PCB 1248 and PCB 1254.
[f]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.

Table 5-178. Summary of Potential Systemic Effects for the Future On-site Adult Resident for SWMU 23 (Building 1345 Outfall)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Anthracene	4.4E-02	3.6E-09	3.0E-01	1.2E-08	
Cadmium	5.2E+01	4.3E-06	1.0E-03	4.3E-03	
Chromium	4.7E+02	3.9E-05	5.0E-03	7.7E-03	
Lead	2.7E+02	NA[d]	NA	NA	
PCBs[e]	3.4E+01	2.8E-06	2.0E-05	1.4E-01	
Phenanthrene	7.5E-02	NA	NA	NA	
Pyrene	9.5E-01	7.8E-08	3.0E-02	2.6E-06	
Total PAHs[f]	1.8E-01	NA	NA	NA	
			Pathway Total:	1.5E-01	0%
Dermal Contact with Surface Soil					
Anthracene	4.4E-02	1.9E-09	2.1E-01	9.2E-09	
Cadmium	5.2E+01	2.3E-06	3.0E-05	7.7E-02	
Chromium	4.7E+02	2.1E-06	2.5E-04	8.2E-03	
Lead	2.7E+02	NA	NA	NA	
PCBs	3.4E+01	1.5E-07	1.9E-05	7.8E-03	
Phenanthrene	7.5E-02	NA	NA	NA	
Pyrene	9.5E-01	4.2E-08	1.5E-02	2.8E-06	
Total PAHs	1.8E-01	NA	NA	NA	
			Pathway Total:	9.3E-02	0%
Inhalation of Particulates					
Anthracene	1.4E-09	NA	NA	NA	
Total PAHs	2.0E-09	NA	NA	NA	
Cadmium	9.9E-08	NA	NA	NA	
Chromium	2.3E-06	NA	NA	NA	
Lead	2.8E-06	NA	NA	NA	
PCBs	4.7E-08	NA	NA	NA	
Phenanthrene	2.7E-09	NA	NA	NA	
Pyrene	3.0E-08	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Anthracene	7.8E-04	1.1E-07	3.0E-01	3.7E-07	
Cadmium	2.0E+00	2.8E-04	1.0E-03	2.8E-01	
Chromium	2.5E-01	3.5E-05	5.0E-03	6.9E-03	
Lead	1.0E+00	NA	NA	NA	
PCBs	4.6E-02	6.4E-06	2.0E-05	3.2E-01	
Phenanthrene	1.3E-03	NA	NA	NA	
Pyrene	4.6E-03	6.4E-07	3.0E-02	2.1E-05	
Total PAHs	2.4E-04	NA	NA	NA	
			Pathway Total:	6.1E-01	2%
Ingestion of Tubers and Fruits					
Anthracene	2.7E-02	1.3E-05	3.0E-01	4.3E-05	
Cadmium	5.5E-01	2.6E-04	1.0E-03	2.6E-01	
Chromium	1.5E-01	7.0E-05	5.0E-03	1.4E-02	
Lead	1.0E+00	NA	NA	NA	
PCBs	1.6E+00	7.5E-04	2.0E-05	3.8E+01	
Phenanthrene	4.5E-02	NA	NA	NA	
Pyrene	1.6E-01	7.5E-05	3.0E-02	2.5E-03	
Total PAHs	8.3E-03	NA	NA	NA	
			Pathway Total:	3.8E+01	98%
			Total CTE HI:	3.9E+01	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Anthracene	1.1E-01	5.6E-08	3.0E-01	1.9E-07	
Cadmium	5.2E+01	2.7E-05	1.0E-03	2.7E-02	
Chromium	4.7E+02	2.4E-04	5.0E-03	4.9E-02	
Lead	2.7E+02	NA	NA	NA	
PCBs	3.4E+01	1.8E-05	2.0E-05	8.8E-01	
Phenanthrene	2.5E-01	NA	NA	NA	
Pyrene	2.2E+00	1.2E-06	3.0E-02	3.9E-05	
Total PAHs	4.5E-01	NA	NA	NA	
			Pathway Total:	9.6E-01	1%

Table 5-178. Summary of Potential Systemic Effects for the Future On-site Adult Resident for SWMU 23 (Building 1345 Outfall) (continued)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Dermal Contact with Surface Soil					
Anthracene	1.1E-01	6.5E-08	2.1E-01	3.1E-07	
Cadmium	5.2E+01	3.2E-05	3.0E-05	1.1E+00	
Chromium	4.7E+02	2.8E-05	2.5E-04	1.1E-01	
Lead	2.7E+02	NA	NA	NA	
PCBs	3.4E+01	2.1E-06	1.9E-05	1.1E-01	
Phenanthrene	2.5E-01	NA	NA	NA	
Pyrene	2.2E+00	1.4E-06	1.5E-02	9.0E-05	
Total PAHs	4.5E-01	NA	NA	NA	
			Pathway Total:	1.3E+00	1%
Inhalation of Particulates					
Anthracene	3.4E-09	NA	NA	NA	
Total PAHs	5.4E-09	NA	NA	NA	
Cadmium	9.9E-08	NA	NA	NA	
Chromium	2.3E-06	NA	NA	NA	
Lead	2.8E-06	NA	NA	NA	
PCBs	4.7E-08	NA	NA	NA	
Phenanthrene	8.5E-09	NA	NA	NA	
Pyrene	7.0E-08	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Anthracene	1.9E-03	9.4E-07	3.0E-01	3.1E-06	
Cadmium	2.0E+00	9.9E-04	1.0E-03	9.9E-01	
Chromium	2.5E-01	1.2E-04	5.0E-03	2.4E-02	
Lead	1.0E+00	NA	NA	NA	
PCBs	4.6E-02	2.3E-05	2.0E-05	1.1E+00	
Phenanthrene	4.3E-03	NA	NA	NA	
Pyrene	1.1E-02	5.3E-06	3.0E-02	1.8E-04	
Total PAHs	5.8E-04	NA	NA	NA	
			Pathway Total:	2.1E+00	2%
Ingestion of Tubers and Fruits					
Anthracene	6.7E-02	1.1E-04	3.0E-01	3.7E-04	
Cadmium	5.5E-01	9.1E-04	1.0E-03	9.1E-01	
Chromium	1.5E-01	2.4E-04	5.0E-03	4.9E-02	
Lead	1.0E+00	NA	NA	NA	
PCBs	1.6E+00	2.6E-03	2.0E-05	1.3E+02	
Phenanthrene	1.5E-01	NA	NA	NA	
Pyrene	3.8E-01	6.3E-04	3.0E-02	2.1E-02	
Total PAHs	2.1E-02	NA	NA	NA	
			Pathway Total:	1.3E+02	97%
			Total RME HI:	1.4E+02	100%

aUnits for the inhalation pathway are mg/m^3.

bSee Appendix L for sources and methodology on estimating a daily intake value.

cSee Appendix M for sources and methodology of toxicity values.

dNA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

ePCB 1248 and PCB 1254.

fBenzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.

Table 5-179. Summary of Potential Systemic Effects for the Future On-site Child Resident for SWMU 23 (Building 1345 Outfall)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Anthracene	4.4E-02	1.6E-08	3.0E-01	5.5E-08	
Cadmium	5.2E+01	1.9E-05	1.0E-03	1.9E-02	
Chromium	4.7E+02	1.7E-04	5.0E-03	3.5E-02	
Lead	2.7E+02	NA[d]	NA	NA	
PCBs[e]	3.4E+01	1.3E-05	2.0E-05	6.3E-01	
Phenanthrene	7.5E-02	NA	NA	NA	
Pyrene	9.5E-01	3.5E-07	3.0E-02	1.2E-05	
Total PAHs[f]	1.8E-01	NA	NA	NA	
			Pathway Total:	6.9E-01	1%
Dermal Contact with Surface Soil					
Anthracene	4.4E-02	3.0E-09	2.1E-01	1.4E-08	
Cadmium	5.2E+01	3.6E-07	6.0E-05	6.0E-03	
Chromium	4.7E+02	3.3E-06	2.5E-04	1.3E-02	
Lead	2.7E+02	NA	NA	NA	
PCBs	3.4E+01	2.4E-06	1.9E-05	1.2E-01	
Phenanthrene	7.5E-02	NA	NA	NA	
Pyrene	9.5E-01	6.6E-08	1.5E-02	4.4E-06	
Total PAHs	1.8E-01	NA	NA	NA	
			Pathway Total:	1.4E-01	0%
Inhalation of Particulates					
Anthracene	1.4E-09	NA	NA	NA	
Total PAHs	2.0E-09	NA	NA	NA	
Cadmium	9.9E-08	NA	NA	NA	
Chromium	2.3E-06	NA	NA	NA	
Lead	2.8E-06	NA	NA	NA	
PCBs[e]	4.7E-08	NA	NA	NA	
Phenanthrene	2.7E-09	NA	NA	NA	
Pyrene	3.0E-08	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Anthracene	7.8E-04	1.8E-07	3.0E-01	5.9E-07	
Cadmium	2.0E+00	4.6E-04	1.0E-03	4.6E-01	
Chromium	2.5E-01	5.6E-05	5.0E-03	1.1E-02	
Lead	1.0E+00	NA	NA	NA	
PCBs	4.6E-02	1.0E-05	2.0E-05	5.2E-01	
Phenanthrene	1.3E-03	NA	NA	NA	
Pyrene	4.6E-03	1.0E-06	3.0E-02	3.5E-05	
Total PAHs	2.4E-04	NA	NA	NA	
			Pathway Total:	9.9E-01	2%
Ingestion of Tubers and Fruits					
Anthracene	2.7E-02	2.1E-05	3.0E-01	7.0E-05	
Cadmium	5.5E-01	4.2E-04	1.0E-03	4.2E-01	
Chromium	1.5E-01	1.1E-04	5.0E-03	2.3E-02	
Lead	1.0E+00	NA	NA	NA	
PCBs	1.6E+00	1.2E-03	2.0E-05	6.1E+01	
Phenanthrene	4.5E-02	NA	NA	NA	
Pyrene	1.6E-01	1.2E-04	3.0E-02	4.1E-03	
Total PAHs	8.3E-03	NA	NA	NA	
			Pathway Total:	6.2E+01	97%
			Total CTE HI:	6.3E+01	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Anthracene	1.8E-01	3.3E-07	3.0E-01	1.1E-06	
Cadmium	5.2E+01	9.7E-05	1.0E-03	9.7E-02	
Chromium	4.7E+02	8.7E-04	5.0E-03	1.7E-01	
Lead	2.7E+02	NA	NA	NA	
PCBs	3.4E+01	6.3E-05	2.0E-05	3.1E+00	
Phenanthrene	4.2E-01	NA	NA	NA	
Pyrene	3.5E+00	6.4E-06	3.0E-02	2.1E-04	
Total PAHs	7.5E-01	NA	NA	NA	
			Pathway Total:	3.4E+00	2%
Dermal Contact with Surface Soil					
Anthracene	1.8E-01	7.6E-08	2.1E-01	3.6E-07	
Cadmium	5.2E+01	2.2E-06	6.0E-05	3.7E-02	

Table 5-179. Summary of Potential Systemic Effects for the Future On-site Child Resident for SWMU 23 (Building 1345 Outfall) (continued)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Chromium	4.7E+02	2.0E-05	2.5E-04	7.9E-02	
Lead	2.7E+02	NA	NA	NA	
PCBs	3.4E+01	1.4E-05	1.9E-05	7.6E-01	
Phenanthrene	4.2E-01	NA	NA	NA	
Pyrene	3.5E+00	1.5E-06	1.5E-02	9.7E-05	
Total PAHs	7.5E-01	NA	NA	NA	
			Pathway Total:	8.7E-01	1%
Inhalation of Particulates					
Anthracene	5.4E-09	NA	NA	NA	
Total PAHs	8.8E-09	NA	NA	NA	
Cadmium	9.9E-08	NA	NA	NA	
Chromium	2.3E-06	NA	NA	NA	
Lead	2.8E-06	NA	NA	NA	
PCBs	4.6E-02	NA	NA	NA	
Phenanthrene	1.4E-08	NA	NA	NA	
Pyrene	1.1E-07	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Anthracene	3.2E-03	1.7E-06	3.0E-01	5.7E-06	
Cadmium	2.0E+00	1.1E-03	1.0E-03	1.1E+00	
Chromium	2.5E-01	1.3E-04	5.0E-03	2.6E-02	
Lead	1.0E+00	NA	NA	NA	
PCBs	4.6E-02	2.5E-05	2.0E-05	1.2E+00	
Phenanthrene	7.2E-03	NA	NA	NA	
Pyrene	1.7E-02	9.0E-06	3.0E-02	3.0E-04	
Total PAHs	9.7E-04	NA	NA	NA	
			Pathway Total:	2.3E+00	2%
Ingestion of Tubers and Fruits					
Anthracene	1.1E-01	2.0E-04	3.0E-01	6.7E-04	
Cadmium	5.5E-01	9.9E-04	1.0E-03	9.9E-01	
Chromium	1.5E-01	2.7E-04	5.0E-03	5.3E-02	
Lead	1.0E+00	NA	NA	NA	
PCBs	1.6E+00	2.9E-03	2.0E-05	1.4E+02	
Phenanthrene	2.5E-01	NA	NA	NA	
Pyrene	5.9E-01	1.1E-03	3.0E-02	3.5E-02	
Total PAHs	3.4E-02	NA	NA	NA	
			Pathway Total:	1.5E+02	96%
			Total RME HI:	1.5E+02	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

[f]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.

[e]PCB 1248 and PCB 1254.

Table 5-180. Summary of Potential Systemic Effects for the Future Construction Worker for SWMU 23 (Building 1345 Outfall)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Subsurface Soil					
Chromium	6.7E+01	3.6E-05	2.0E-02	1.8E-03	
PCB 1248	1.6E-01	8.5E-08	2.0E-05	4.2E-03	
			Pathway Total:	6.1E-03	95%
Dermal Contact with Subsurface Soil					
Chromium	6.7E+01	1.3E-07	1.0E-03	1.3E-04	
PCB 1248	1.6E-01	3.0E-09	1.9E-05	1.6E-04	
			Pathway Total:	2.9E-04	5%
Inhalation of Particulates					
Chromium	1.7E-04	NA[d]	NA	NA	
PCB 1248	4.2E-07	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	6.4E-03	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Subsurface Soil					
Chromium	6.7E+01	1.7E-04	2.0E-02	8.5E-03	
PCB 1248	1.6E-01	4.0E-07	2.0E-05	2.0E-02	
			Pathway Total:	2.8E-02	81%
Dermal Contact with Subsurface Soil					
Chromium	6.7E+01	3.0E-06	1.0E-03	3.0E-03	
PCB 1248	1.6E-01	7.0E-08	1.9E-05	3.7E-03	
			Pathway Total:	6.7E-03	19%
Inhalation of Particulates					
Chromium	1.7E-04	NA	NA	NA	
PCB 1248	4.2E-07	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	3.5E-02	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-181. Summary of Potential Systemic Effects for the Current/Future On-site Laborer for SWMU 23 (Asphalt and Stained Areas)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Chromium	1.6E+02	3.9E-07	2.0E-02	1.9E-05	
Total PAHs[d]	1.2E-01	NA[e]	NA	NA	
			Pathway Total:	1.9E-05	50%
Dermal Contact with Surface Soil					
Chromium	1.6E+02	1.9E-08	1.0E-03	1.9E-05	
Total PAHs	1.2E-01	NA	NA	NA	
			Pathway Total:	1.9E-05	50%
Inhalation of Particulates					
Anthracene	3.4E-09	NA	NA	NA	
Total PAHs	5.8E-09	NA	NA	NA	
Cadmium	9.9E-08	NA	NA	NA	
Chromium	2.3E-06	NA	NA	NA	
Lead	2.8E-06	NA	NA	NA	
PCBs[f]	4.7E-08	NA	NA	NA	
Phenanthrene	6.8E-09	NA	NA	NA	
Pyrene	7.7E-08	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	3.9E-05	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Chromium	1.6E+02	3.7E-05	5.0E-03	7.4E-03	
Total PAHs	1.3E-01	NA	NA	NA	
			Pathway Total:	7.4E-03	30%
Dermal Contact with Surface Soil					
Chromium	1.6E+02	4.3E-06	2.5E-04	1.7E-02	
Total PAHs	1.3E-01	NA	NA	NA	
			Pathway Total:	1.7E-02	70%
Inhalation of Particulates					
Anthracene	3.7E-09	NA	NA	NA	
Total PAHs	6.5E-09	NA	NA	NA	
Cadmium	9.9E-08	NA	NA	NA	
Chromium	2.3E-06	NA	NA	NA	
Lead	2.8E-06	NA	NA	NA	
PCBs	4.7E-08	NA	NA	NA	
Phenanthrene	1.0E-08	NA	NA	NA	
Pyrene	8.3E-08	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	2.5E-02	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
[e]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.
[f]PCB 1248 and PCB 1254.

Table 5-182. Summary of Potential Systemic Effects for the Future On-Site Adult Resident for SWMU 23 (Asphalt and Stained Areas)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Chromium	1.6E+02	1.3E-05	5.0E-03	2.7E-03	
Total PAHs(d)	4.5E-02	NA(e)	NA	NA	
			Pathway Total:	2.7E-03	21%
Dermal Contact with Surface Soil					
Chromium	1.6E+02	6.7E-07	2.5E-04	2.7E-03	
Total PAHs	4.5E-02	NA	NA	NA	
			Pathway Total:	2.7E-03	21%
Inhalation of Particulates					
Anthracene	1.4E-09	NA	NA	NA	
Total PAHs	2.0E-09	NA	NA	NA	
Cadmium	9.9E-08	NA	NA	NA	
Chromium	2.3E-06	NA	NA	NA	
Lead	2.8E-06	NA	NA	NA	
PCBs(f)	4.7E-08	NA	NA	NA	
Phenanthrene	2.7E-09	NA	NA	NA	
Pyrene	3.0E-08	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Chromium	8.5E-02	1.2E-05	5.0E-03	2.4E-03	
Total PAHs	5.9E-05	NA	NA	NA	
			Pathway Total:	2.4E-03	19%
Ingestion of Tubers and Fruits					
Chromium	5.1E-02	2.4E-05	5.0E-03	4.8E-03	
Total PAHs	2.1E-03	NA	NA	NA	
			Pathway Total:	4.8E-03	38%
			Total CTE HI:	1.3E-02	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Chromium	1.6E+02	8.4E-05	5.0E-03	1.7E-02	
Total PAHs	1.1E-01	NA	NA	NA	
			Pathway Total:	1.7E-02	21%
Dermal Contact with Surface Soil					
Chromium	1.6E+02	9.8E-06	2.5E-04	3.9E-02	
Total PAHs	1.1E-01	NA	NA	NA	
			Pathway Total:	3.9E-02	48%
Inhalation of Particulates					
Anthracene	3.4E-09	NA	NA	NA	
Total PAHs	5.4E-09	NA	NA	NA	
Cadmium	9.9E-08	NA	NA	NA	
Chromium	2.3E-06	NA	NA	NA	
Lead	2.8E-06	NA	NA	NA	
PCBs	4.7E-08	NA	NA	NA	
Phenanthrene	8.5E-09	NA	NA	NA	
Pyrene	7.0E-08	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Chromium	8.5E-02	4.2E-05	5.0E-03	8.3E-03	
Total PAHs	1.5E-04	NA	NA	NA	
			Pathway Total:	8.3E-03	10%
Ingestion of Tubers and Fruits					
Chromium	5.1E-02	8.4E-05	5.0E-03	1.7E-02	
Total PAHs	5.2E-03	NA	NA	NA	
			Pathway Total:	1.7E-02	21%
			Total RME HI:	8.1E-02	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
[e]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.
[f]PCB 1248 and PCB 1254.

Table 5-183. Summary of Potential Systemic Effects for the Future On-Site Child Resident for SWMU 23 (Asphalt and Stained Areas)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Chromium	1.6E+02	6.0E-05	5.0E-03	1.2E-02	
Total PAHs[d]	4.5E-02	NA[e]	NA	NA	
			Pathway Total:	1.2E-02	43%
Dermal Contact with Surface Soil					
Chromium	1.6E+02	1.1E-06	2.5E-04	4.5E-03	
Total PAHs	4.5E-02	NA	NA	NA	
			Pathway Total:	4.5E-03	16%
Inhalation of Particulates					
Anthracene	1.4E-09	NA	NA	NA	
Total PAHs	2.0E-09	NA	NA	NA	
Cadmium	9.9E-08	NA	NA	NA	
Chromium	2.3E-06	NA	NA	NA	
Lead	2.8E-06	NA	NA	NA	
PCBs[f]	4.7E-08	NA	NA	NA	
Phenanthrene	2.7E-09	NA	NA	NA	
Pyrene	3.0E-08	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Chromium	8.5E-02	1.9E-05	5.0E-03	3.9E-03	
Total PAHs[d]	5.9E-05	NA	NA	NA	
			Pathway Total:	3.9E-03	14%
Ingestion of Tubers and Fruits					
Chromium	5.1E-02	3.9E-05	5.0E-03	7.8E-03	
Total PAHs	2.1E-03	NA	NA	NA	
			Pathway Total:	7.8E-03	28%
			Total CTE HI:	2.8E-02	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Chromium	1.6E+02	3.0E-04	5.0E-03	6.0E-02	
Total PAHs	1.9E-01	NA	NA	NA	
			Pathway Total:	6.0E-02	52%
Dermal Contact with Surface Soil					
Chromium	1.6E+02	6.8E-06	2.5E-04	2.7E-02	
Total PAHs	1.9E-01	NA	NA	NA	
			Pathway Total:	2.7E-02	24%
Inhalation of Particulates					
Anthracene	5.4E-09	NA	NA	NA	
Total PAHs	8.8E-09	NA	NA	NA	
Cadmium	9.9E-08	NA	NA	NA	
Chromium	2.3E-06	NA	NA	NA	
Lead	2.8E-06	NA	NA	NA	
PCBs	4.7E-08	NA	NA	NA	
Phenanthrene	1.4E-08	NA	NA	NA	
Pyrene	1.1E-07	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Leafy Vegetables					
Chromium	8.5E-02	4.6E-05	5.0E-03	9.1E-03	
Total PAHs	2.5E-04	NA	NA	NA	
			Pathway Total:	9.1E-03	8%
Ingestion of Tubers and Fruits					
Chromium	5.1E-02	9.2E-05	5.0E-03	1.8E-02	
Total PAHs	8.6E-03	NA	NA	NA	
			Pathway Total:	1.8E-02	16%
			Total RME HI:	1.1E-01	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
[e]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.
[f]PCB 1248 and PCB 1254.

Table 5-184. Summary of Potential Systemic Effects for the Future Construction Worker for SWMU 23 (Asphalt and Stained Areas)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Subsurface Soil					
Chromium	1.2E+02	6.4E-05	2.0E-02	3.2E-03	
Total PAHs[d]	4.9E-02	NA[e]	NA	NA	
			Pathway Total:	3.2E-03	93%
Dermal Contact with Subsurface Soil					
Chromium	1.2E+02	2.3E-07	1.0E-03	2.3E-04	
Total PAHs	4.9E-02	NA	NA	NA	
			Pathway Total:	2.3E-04	7%
Inhalation of Particulates					
Chromium	3.0E-04	NA	NA	NA	
Total PAHs	1.3E-07	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	3.4E-03	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Subsurface Soil					
Chromium	1.2E+02	3.0E-04	2.0E-02	1.5E-02	
Total PAHs	1.2E-01	NA	NA	NA	
			Pathway Total:	1.5E-02	74%
Dermal Contact with Subsurface Soil					
Chromium	1.2E+02	5.3E-06	1.0E-03	5.3E-03	
Total PAHs	1.2E-01	NA	NA	NA	
			Pathway Total:	5.3E-03	26%
Inhalation of Particulates					
Chromium	3.0E-04	NA	NA	NA	
Total PAHs	3.1E-07	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	2.0E-02	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.

[e]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-185. Summary of Potential Systemic Effects for the Current/Future On-site Laborer for SWMU 23 as a Whole

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Anthracene	1.0E-01	2.4E-10	3.0E+00	7.9E-11	
Cadmium	2.9E+00	6.9E-09	1.0E-03	6.9E-06	
Chromium	6.8E+01	1.6E-07	2.0E-02	8.0E-06	
Lead	8.7E+01	NA(d)	NA	NA	
PCBs(e)	1.4E+00	3.3E-09	2.0E-05	1.6E-04	
Phenanthrene	2.0E-01	NA	NA	NA	
Pyrene	2.3E+00	5.4E-09	3.0E-01	1.8E-08	
Total PAHs(f)	1.7E-01	NA	NA	NA	
			Pathway Total:	1.8E-04	64%
Dermal Contact with Surface Soil					
Anthracene	1.0E-01	1.2E-10	2.1E+00	5.7E-11	
Cadmium	2.9E+00	3.5E-10	6.0E-05	5.8E-06	
Chromium	6.8E+01	8.0E-09	1.0E-03	8.0E-06	
Lead	8.7E+01	NA	NA	NA	
PCBs	1.4E+00	1.6E-09	1.9E-05	8.6E-05	
Phenanthrene	2.0E-01	NA	NA	NA	
Pyrene	2.3E+00	2.7E-09	1.5E-01	1.8E-08	
Total PAHs	1.7E-01	NA	NA	NA	
			Pathway Total:	1.0E-04	36%
Inhalation of Particulates					
Anthracene	3.4E-09	NA	NA	NA	
PAHs	5.8E-09	NA	NA	NA	
Cadmium	9.9E-08	NA	NA	NA	
Chromium	2.3E-06	NA	NA	NA	
Lead	2.8E-06	NA	NA	NA	
PCBs	4.7E-08	NA	NA	NA	
Phenanthrene	6.8E-09	NA	NA	NA	
Pyrene	7.7E-08	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	2.8E-04	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Anthracene	1.1E-01	2.5E-08	3.0E+00	8.4E-09	
Cadmium	2.9E+00	6.6E-07	1.0E-03	6.6E-04	
Chromium	6.8E+01	1.5E-05	5.0E-03	3.1E-03	
Lead	8.7E+01	NA	NA	NA	
PCBs	1.4E+00	3.1E-07	2.0E-05	1.6E-02	
Phenanthrene	3.0E-01	NA	NA	NA	
Pyrene	2.4E+00	5.6E-07	3.0E-02	1.9E-05	
Total PAHs	1.9E-01	NA	NA	NA	
			Pathway Total:	1.9E-02	41%
Dermal Contact with Surface Soil					
Anthracene	1.1E-01	2.9E-08	2.1E-01	1.4E-07	
Cadmium	2.9E+00	7.7E-08	6.0E-05	1.3E-03	
Chromium	6.8E+01	1.8E-06	2.5E-04	7.2E-03	
Lead	8.7E+01	NA	NA	NA	
PCBs	1.4E+00	3.7E-07	1.9E-05	1.9E-02	
Phenanthrene	3.0E-01	NA	NA	NA	
Pyrene	2.4E+00	6.5E-07	1.5E-02	4.3E-05	
Total PAHs	1.9E-01	NA	NA	NA	
			Pathway Total:	2.8E-02	59%
Inhalation of Particulates					
Anthracene	3.7E-09	NA	NA	NA	
Cadmium	6.5E-09	NA	NA	NA	
Chromium	9.9E-08	NA	NA	NA	
Lead	2.3E-06	NA	NA	NA	
PCBs	2.8E-06	NA	NA	NA	
Phenanthrene	4.7E-08	NA	NA	NA	
Pyrene	1.0E-08	NA	NA	NA	
Total PAHs	8.3E-08	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	4.7E-02	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.
[e]PCB 1248 and PCB 1254.
[f]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.

5.5.4.7.1 *Characterization of Potential Carcinogenic Risks.* The USEPA currently classifies lead salts as probable human carcinogens (Class B2). However, quantifying lead's cancer risk involves many uncertainties, some of which may be unique to lead. Age, health, nutritional state, body burden, and exposure duration influence the absorption, release, and excretion of lead. In addition, current knowledge of lead pharmacokinetics indicates that an estimate derived by standard procedures would not truly describe the potential risk. Thus, the USEPA's Carcinogen Assessment Group recommends that a numerical estimate not be used (USEPA 1995a).

Building 1343 Outfall Area of Concern. The general process used to select the COPCs associated with the Building 1343 Outfall area of concern is described in Section 3.1.1. COPC selection for SWMU 23 is described in Section 5.5.4.2. For current and future land use scenarios, cadmium, chromium, lead, anthracene, phenanthrene, pyrene, PCBs, and total c-PAHs were identified as COPCs. Chromium, a known human carcinogen, and cadmium and PCB 1254, suspected human carcinogens, are the only COPCs that contribute to the carcinogenic risk. Tables 5-143 and 5-144 list the COPCs and their associated media.

Current/Future On-site Laborer. The cumulative ILCR for all pathways is 1.9E-06 and 5.1E-09 for the RME and CTE scenarios, respectively. As summarized in Table 5-152, the driving pathway is inhalation of particulates, which contributes greater than 56 percent of the estimated risk.

Total ILCR for inhalation of particulates by laborers is 1.1E-06 and 4.4E-09 for the RME and CTE scenarios, respectively. Ingestion of and dermal contact with surface soil do not present an individual risk above the lower bound of the target risk range. The estimated ILCRs for these pathways range from 4.6E-07 to 2.5E-10. Chromium is the major contributor to the estimated risks.

Future On-site Adult Resident. The cumulative ILCR for all pathways is 1.6E-04 and 1.2E-05 for the RME and CTE scenarios, respectively. As summarized in Table 5-153, the driving pathway is ingestion of tubers, which contributes greater than 97 percent of the estimated risk.

Incremental lifetime cancer risk attributed to inhalation of particulates by adults results in an estimated ILCR of 1.9E-06 and 3.5E-07 using RME and CTE parameters, respectively. Dermal contact with surface soil by adults during yard work, gardening, etc., results in an estimated ILCR of 1.3E-06 using RME conditions and 2.3E-08 using the CTE conditions. The total ILCR for ingestion of surface soil is 1.0E-06 and 4.4E-08 for the RME and CTE scenarios, respectively. The ILCR for ingestion of produce are 1.6E-04 and 1.2E-05, respectively. PCB is the major contributor to the risk estimate.

Future On-site Child Resident. The cumulative ILCR for all pathways is 1.1E-04 and 2.2E-05 for the RME and CTE scenarios, respectively. As summarized in Table 5-154, the driving pathway is ingestion of tubers, which contributes greater than 94 percent of the estimated risk.

Incremental lifetime cancer risk attributed to inhalation of particulates by children results in an estimated ILCR of 2.9E-06 and 1.8E-06 using RME and CTE parameters, respectively. Dermal contact with surface soil by children during yard work, playing, etc., results in an estimated ILCR of 5.3E-07 using RME conditions and 3.9E-08 using the CTE conditions. The total ILCR for ingestion of surface soil is 2.2E-06 and 2.0E-07 for the RME and CTE scenarios, respectively. The ILCR for ingestion of produce are 1.0E-04 and 2.2-05, respectively. PCB is the major contributor to the risk estimate.

Future Construction Worker. The cumulative ILCR for all pathways is 7.7E-06 and 5.8E-07 for the RME and CTE scenarios, respectively. As summarized in Table 5-155, the only contributing pathway is inhalation of particulates, resulting in an estimated ILCR of 7.7E-06 and 5.8E-07 using RME and CTE parameters, respectively. Oral toxicity information is not available for chromium at this time; therefore, ingestion of and dermal contact with subsurface soil were not estimated.

Outfall Near Building 1344 Area of Concern. The general process used to select the COPCs associated with the Outfall Near Building 1344 area of concern is described in Section 3.1.1. COPC selection for SWMU 23 is described in Section 5.5.4.2. For current and future land use scenarios, cadmium, chromium, lead, anthracene, phenanthrene, pyrene, PCBs, and total c-PAHs were identified as COPCs. Chromium, a known human carcinogen, and cadmium, c-PAHs, and PCB 1254, suspected human carcinogens, are the only COPCs that contribute to the carcinogenic risk. Tables 5-145 and 5-146 list the COPCs and their associated media.

Current/Future On-site Laborer. The cumulative ILCR for all pathways is 1.3E-06 and 4.6E-09 for the RME and CTE scenarios, respectively. As summarized in Table 5-156, the driving pathway is inhalation of particulates, which contributes greater than 82 percent of the estimated risk.

Total ILCR for inhalation of particulates by laborers is 1.1E-06 and 4.4E-09 for the RME and CTE scenarios, respectively. Ingestion of and dermal contact with surface soil do not present an individual risk above the lower bound of the target risk range. The estimated ILCRs for these pathways range from 1.4E-07 to 7.3E-11. Chromium is the major contributor to the estimated risks.

Future On-site Adult Resident. The cumulative ILCR for all pathways is 3.7E-05 and 2.5E-06 for the RME and CTE scenarios, respectively. As summarized in Table 5-157, the driving pathway is ingestion of produce contributing 92% of estimated risks for the RME scenario and 86% for the CTE scenario.

Incremental lifetime cancer risk attributed to ingestion of produce, such as homegrown tubers, fruits, and vegetables by adults, results in an estimated ILCR of 3.4E-05 and 2.1E-06 using RME and CTE parameters, respectively. Inhalation of particulates by adults results in an estimated ILCR of 1.9E-06 using RME conditions and 3.5E-07 using the CTE conditions. The ILCRs for the remaining pathways evaluated—ingestion of and dermal contact with surface soil—are below the target risk range for both the RME and CTE scenarios, and range from

3.6E-07 to 4.7E-09. For the ingestion of produce pathway, total PCBs are the major contributor. Chromium is the major contributor for the inhalation of particulates pathway.

Future On-site Child Resident. The cumulative ILCR for all pathways is 3.1E-05 and 5.3E-06 for the RME and CTE scenarios, respectively. As summarized in Table 5-158, the driving pathway is ingestion of produce, contributing 88 percent to the RME scenario and 68 percent to the CTE scenario.

Incremental lifetime cancer risk attributed to ingestion of produce, such as homegrown tubers, fruits, and vegetables by children, results in an estimated ILCR of 2.7E-05 and 3.5E-06 using RME and CTE parameters, respectively. Inhalation of particulates by children results in an estimated ILCR of 2.9E-06 using RME conditions and 1.8E-06 using the CTE conditions. The ILCRs for the remaining pathways evaluated—ingestion of and dermal contact with surface soil—are below the target risk range for both the RME and CTE scenarios, and range from 5.9E-07 to 7.9E-09. For the ingestion of produce pathway, PCBs are the major contributor. Chromium is the major contributor for the inhalation of particulates pathway.

Future Construction Worker. The cumulative ILCR for all pathways is 7.6E-05 and 5.8E-06 for the RME and CTE scenarios, respectively. As summarized in Table 5-159, the driving pathway is inhalation of particulates, which contributes nearly 100 percent of the estimated risk.

Total ILCR for inhalation of particulates by laborers is 7.6E-05 and 5.8E-06 for the RME and CTE scenarios, respectively. Ingestion of and dermal contact with subsurface soil do not present an individual risk above the lower bound of the target risk range. The estimated ILCRs for these pathways range from 4.2E-08 to 9.1E-11. Chromium is the major contributor to the estimated risks.

Building 1345 Outfall Area of Concern. The general process used to select the COPCs associated with the Building 1345 Outfall area of concern is described in Section 3.1.1. COPC selection for SWMU 23 is described in Section 5.5.4.2. For current and future land use scenarios, cadmium, chromium, lead, anthracene, phenanthrene, pyrene, PCBs, and total c-PAHs were identified as COPCs. Chromium, a known human carcinogen, and cadmium and PCB 1254, suspected human carcinogens, are the only COPCs that contribute to the carcinogenic risk. Tables 5-147 and 5-148 list the COPCs and their associated media.

Current/Future On-site Laborer. The cumulative ILCR for all pathways is 4.6E-05 and 4.3E-08 for the RME and CTE scenarios, respectively. As summarized in Table 5-160, the driving pathway is dermal contact with surface soil (54 percent) for the RME scenario and ingestion of surface soil (59 percent) for the CTE scenario.

Total ILCR for dermal contact with surface soil by laborers is 2.5E-05 and 1.3E-08 for the RME and CTE scenarios, respectively. For ingestion of surface soil by laborers, the estimated ILCR is 2.0E-05 and 2.5E-08 for the RME and CTE scenarios, respectively. Inhalation of particulates does not present an individual risk above the lower bound of the target risk range. Chromium is the major contributor to the estimated risks.

Future On-site Adult Resident. The cumulative ILCR for all pathways is 8.4E-03 and 6.3E-04 for the RME and CTE scenarios, respectively. As summarized in Table 5-161, the driving pathway is ingestion of produce, which contributes greater than 99 percent of the estimated risk.

Incremental lifetime cancer risk attributed to ingestion of produce , such as homegrown tubers, fruits, and vegetables by adults, results in an estimated ILCR of 8.2E-03 and 6.02E-04 using RME and CTE parameters, respectively. Dermal contact with surface soil by adults results in an estimated ILCR of 6.8E-05 and 1.2E-06 for the RME and CTE scenarios. The total ILCR for ingestion of surface soil is 5.5E-05 and 2.3E-06 for the RME and CTE scenarios. Inhalation of particulates by adults results in an estimated ILCR of 1.9E-06 using RME conditions and 3.5E-07 using the CTE conditions. For the ingestion of produce pathway, PCBs are the major contributors; total PCBs are the major contributors for the ingestion of and dermal contact with surface soil pathways; and chromium is the major contributor for the inhalation of particulates pathway.

Future On-site Child Resident. The cumulative ILCR for all pathways is 5.6E-03 and 1.0E-03 for the RME and CTE scenarios, respectively. As summarized in Table 5-162, the driving pathway is ingestion of produce, which contributes greater than 97 percent of the estimated risk.

The total ILCR for ingestion of surface soil is 1.2E-04 and 1.0E-05 for the RME and CTE scenarios. Incremental lifetime cancer risk attributed to ingestion of produce results in an estimated ILCR of 5.4E-03 and 1.0E-03 using RME and CTE parameters, respectively. Dermal contact with surface soil by children results in an estimated ILCR of 2.9E-05 and 2.1E-06 for the RME and CTE scenarios. Inhalation of particulates by children results in an estimated ILCR of 2.9E-06 using RME conditions and 1.8E-06 using the CTE conditions. For the ingestion of produce pathway, PCBs are the major contributors; total PCBs are the major contributors for the ingestion of and dermal contact with surface soil pathways; and chromium is the major contributor for the inhalation of particulates pathway.

Future Construction Worker. The cumulative ILCR for all pathways is 9.5E-06 and 7.2E-07 for the RME and CTE scenarios, respectively. As summarized in Table 5-163, the driving pathway is inhalation of particulates, which contributes greater than 98 percent of the estimated risk.

Total ILCR for inhalation of particulates by construction workers is 9.4E-06 and 7.1E-07 for the RME and CTE scenarios, respectively. Ingestion of and dermal contact with subsurface soil do not present an individual risk above the lower bound of the target risk range. The estimated ILCRs for these pathways range from 1.2E-07 to 3.3E-10. Chromium is the major contributor to the estimated risks.

Asphalt and Stained Area of Concern. The general process used to select the COPCs associated with the Asphalt and Stained area of concern is described in Section 3.1.1. COPC selection for SWMU 23 is described in Section 5.5.4.2. For current and future land use

scenarios, cadmium, chromium, lead, anthracene, phenanthrene, pyrene, PCBs, and total c-PAHs were identified as COPCs. Chromium, a known human carcinogen, and cadmium and total c-PAHs, suspected human carcinogens, are the only COPCs that contribute to the carcinogenic risk. Tables 5-149 and 5-150 list the COPCs and their associated media.

Current/Future On-site Laborer. The cumulative ILCR for all pathways is 1.3E-06 and 4.6E-09 for the RME and CTE scenarios, respectively. As summarized in Table 5-164, the driving pathway is inhalation of particulates, which contributes greater than 82 percent of the estimated risk.

Total ILCR for inhalation of particulates by laborers is 1.1E-06 and 4.4E-09 for the RME and CTE scenarios, respectively. For the remaining pathways evaluated—ingestion of and dermal contact with surface soil—the estimated ILCRs are below the lower limit of the target risk range. The total ILCRs for these pathways range from 1.7E-07 to 8.3E-11. Chromium is the major contributor to the estimated risks.

Future On-site Adult Resident. The cumulative ILCR for all pathways is 2.7E-05 and 1.1E-06 for the RME and CTE scenarios, respectively. As summarized in Table 5-165, the driving pathway is ingestion of produce, which contributes greater than 69 percent of the estimated risk.

Incremental lifetime cancer risk attributed to ingestion of produce results in an estimated ILCR of 2.5E-05 and 8.3E-07 using RME and CTE parameters, respectively. Inhalation of particulates by adults results in an estimated ILCR of 1.9E-06 using RME conditions and 3.5E-07 using the CTE conditions. For the remaining pathways evaluated—ingestion of surface soil and dermal contact with surface soil—the estimated ILCRs are below the lower limit of the target risk range. The total ILCRs for these pathways range from 4.0E-07 to 2.9E-09. For the ingestion of produce pathway, c-PAHs are the major contributors, and chromium is the major contributor for the inhalation of particulates pathway.

Future On-site Child Resident. The cumulative ILCR for all pathways is 3.1E-05 and 3.1E-06 for the RME and CTE scenarios, respectively. As summarized in Table 5-166, the driving pathway is ingestion of produce (88 percent) for the RME scenario and inhalation of particulates (57 percent) for the CTE scenario.

Incremental lifetime cancer risk attributed to ingestion of produce results in an estimated ILCR of 2.7E-05 and 1.3E-06 using RME and CTE parameters, respectively. Inhalation of particulates by children results in an estimated ILCR of 2.9E-06 using RME conditions and 1.8E-06 using the CTE conditions. The ILCRs for the remaining pathways evaluated—ingestion of and dermal contact with surface soil—are below the target risk range for both the RME and CTE scenarios, and range from 6.0E-07 to 4.8E-09. For the ingestion of produce pathway, c-PAHs are the major contributors, and chromium is the major contributor for the inhalation of particulates pathway.

Future Construction Worker. The cumulative ILCR for all pathways is 1.6E-05 and 1.2E-06 for the RME and CTE scenarios, respectively. As summarized in Table 5-167, the driving pathway is inhalation of particulates, which contributes greater than 99 percent of the estimated risk.

Total ILCR for inhalation of particulates by construction workers is 1.6E-05 and 1.2E-06 for the RME and CTE scenarios, respectively. Ingestion of and dermal contact with subsurface soil do not present an individual risk above the lower bound of the target risk range. The estimated ILCRs for these pathways range from 8.6E-08 to 1.9E-10. Chromium is the major contributor to the estimated risks.

SWMU 23 as a Whole. The general process used to select the COPCs associated with the SWMU 23 is described in Section 3.1.1. COPC selection for SWMU 23 is described in Section 5.5.4.2. For current and future land use scenarios, cadmium, chromium, lead, anthracene, phenanthrene, pyrene, PCBs, and total c-PAHs were identified as COPCs.

Chromium, a known human carcinogen, and cadmium, c-PAHs, and PCB 1254, suspected human carcinogens, are the only COPCs that contribute to the carcinogenic risk. Table 5-151 lists the COPCs and their associated media.

Current/Future On-site Laborer. The cumulative ILCR for all pathways is 3.2E-06 and 6.2E-09 for the RME and CTE scenarios, respectively. As summarized in Table 5-168, the driving pathway is dermal contact with surface soil, 38 percent, and inhalation of particulates, 71 percent, for the CTE scenario.

For the dermal contact with surface soil pathway, the total ILCR is 1.2E-06 and 6.5E-10 for the RME and CTE scenarios. Total ILCR for inhalation of particulates by laborers is 1.1E-06 and 4.4E-09 for the RME and CTE scenarios, respectively. Ingestion of surface soil does not present an individual risk above the lower bound of the target risk range. Chromium is the major contributor to the estimated risks.

5.5.4.7.2 *Characterization of Potential Systemic Effects*

Building 1343 Outfall Area of Concern. The general process used to select the COPCs associated with the Building 1343 Outfall area of concern is described in Section 3.1.1. COPC selection for SWMU 23 is described in Section 5.5.4.2. For current and future land use scenarios, cadmium, chromium, lead, anthracene, phenanthrene, pyrene, PCBs, and total c-PAHs were identified as COPCs. Only PCB 1254 and chromium were evaluated for potential systemic effects because noncarcinogenic toxicity information is not available for the remaining COPCs associated with this area of concern. Noncarcinogenic inhalation toxicity information was not available at this point in time; therefore, the inhalation of particulates pathway was not quantitatively evaluated. Tables 5-143 and 5-144 list the COPCs and their associated media.

Current/Future On-site Laborer. As summarized in Table 5-169, the summed HI for all pathways does not exceed unity (one) and ranges from 1.6E-02 to 1.2E-04 for the RME and CTE scenarios, respectively. The driving pathway is dermal contact with surface soil, 55 percent, for the RME scenario and ingestion of surface soil, 66 percent, for the CTE scenario. The sole contributor to the risk estimates is PCB 1254.

Future On-site Adult Resident. As summarized in Table 5-170, the summed HI for all pathways ranges from 2.6E+00 to 7.4E-01 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of tubers and fruits, contributing 98 percent for the RME scenario and 99 percent, for the CTE scenario. The sole contributor to the risk estimates is PCB 1254.

Future On-site Child Resident. As summarized in Table 5-171, the summed HI for all pathways ranges from 2.9E+00 to 1.2E+00 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of tubers and fruits, greater than 97 percent of the total risk estimate.

Future Construction Worker. As summarized in Table 5-172, the summed HI for all pathways does not exceed unity (one) and ranges from 5.6E-03 to 1.2E-03 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of surface soil, which is greater than 99 percent of the total risk estimate.

Outfall Near Building 1344 Area of Concern. The general process used to select the COPCs associated with the Outfall Near Building 1344 area of concern is described in Section 3.1.1. COPC selection for SWMU 23 is described in Section 5.5.4.2. For current and future land use scenarios, cadmium, chromium, lead, anthracene, phenanthrene, pyrene, PCBs, and total c-PAHs were identified as COPCs. Only PCB 1254 and chromium were evaluated for potential systemic effects because noncarcinogenic toxicity information is not available for the remaining COPCs associated with this area of concern. Noncarcinogenic inhalation toxicity information was not available at this point in time; therefore, the inhalation of particulates pathway was not quantitatively evaluated. Tables 5-145 and 5-146 list the COPCs and their associated media.

Current/Future On-site Laborer. As summarized in Table 5-173, the summed HI for all pathways does not exceed unity (one) and ranges from 9.1E-03 to 2.3E-05 for the RME and CTE scenarios, respectively. The driving pathway is dermal contact with surface soil (66 percent) for the RME scenario and ingestion of surface soil (73 percent) for the CTE scenario. The sole contributors to the risk estimates are chromium and PCB 1254.

Future On-site Adult Resident. As summarized in Table 5-174, the summed HI for all pathways does not exceed unity (one) and ranges from 4.2E-01 to 1.2E-01 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of produce, contributing 94 percent of RME HI and 97 percent of CTE HI. The sole contributors to the risk estimates are chromium and PCB 1254.

Future On-site Child Resident. As summarized in Table 5-175, the summed HI for all pathways does not exceed unity (one) and ranges from 4.7E-01 to 1.9E-01 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of produce, which is greater than 91 percent of the total risk estimate (RME). The sole contributors to the risk estimates are chromium and PCB 1254.

Future Construction Worker. As summarized in Table 5-176, the summed HI for all pathways does not exceed unity (one) and ranges from 9.3E-02 to 1.6E-02 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of surface soil, which is greater than 93 percent of the total risk estimate. The sole contributor to the risk estimates is chromium.

Building 1345 Outfall Area of Concern. The general process used to select the COPCs associated with the Building 1345 Outfall area of concern is described in Section 3.1.1. COPC selection for SWMU 23 is described in Section 5.5.4.2. For current and future land use scenarios, cadmium, chromium, lead, anthracene, phenanthrene, pyrene, PCBs, and total c-PAHs were identified as COPCs. All COPCs were evaluated for systemic effects with the exception of lead, phenanthrene, and total c-PAHs. Noncarcinogenic inhalation toxicity information was not available at this point in time; therefore, the inhalation of particulates pathway was not quantitatively evaluated. Tables 5-147 and 5-148 list the COPCs and their associated media.

Current/Future On-site Laborer. As summarized in Table 5-177, the summed HI for all pathways does not exceed unity (one) and ranges from 9.7E-01 to 6.5E-03 for the RME and CTE scenarios, respectively. The driving pathway is dermal contact with surface soil (57 percent) for the RME scenario and ingestion of surface soil (65 percent) for the CTE scenario. The major contributor to the risk estimates is PCB 1254.

Future On-site Adult Resident. As summarized in Table 5-178, the summed HI for all pathways ranges from 1.4E+02 to 3.9E+01 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of produce, which contributes greater than 97 percent of the total HI.

The total HI for ingestion of produce by adult residents is 1.3E+02 and 3.8E+01 for the RME and CTE scenarios, respectively. For the dermal contact with surface soil by adults during gardening, yardwork, etc., the total HI ranges from 1.3E+00 to 9.3E-02 for the RME and CTE scenarios, respectively. The HIs for the remaining pathway evaluated, ingestion of surface soil, is below unity (one) and range from 9.6E-01 to 1.5E-01. PCB is the major contributor to the estimated HI.

Future On-site Child Resident. As summarized in Table 5-179, the summed HI for all pathways ranges from 1.5E+02 to 6.3E+01 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of produce—99 percent of the total HI for the RME scenario and 98 percent for the CTE scenario.

For the ingestion of surface soil pathway, the total HI is 3.4E+00 and 6.9E-01 for the RME and CTE scenarios, respectively. The total HI for ingestion of produce by child residents is

1.5E+02 and 6.3E+01 for the RME and CTE scenarios, respectively. The HIs for the remaining pathway evaluated, dermal contact with surface soil, is below unity (one) and range from 8.7E-01 to 1.4E-01. PCB is the major contributor to the estimated HI.

Future Construction Worker. As summarized in Table 5-180, the summed HI for all pathways does not exceed unity (one) and ranges from 3.5E-02 to 6.4E-03 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of surface soil, which is greater than 81 percent of the total risk estimate.

Asphalt and Stained Outfall Area of Concern. The general process used to select the COPCs associated with the Asphalt and Stained area of concern is described in Section 3.1.1. COPC selection for SWMU 23 is described in Section 5.5.4.2. For current and future land use scenarios, cadmium, chromium, lead, anthracene, phenanthrene, pyrene, PCBs, and total c-PAHs were identified as COPCs. Only chromium was evaluated for potential systemic effects because noncarcinogenic toxicity information is not available for the remaining COPCs associated with this area of concern. Noncarcinogenic inhalation toxicity information is not available at this point in time; therefore, the inhalation of particulates pathway is not quantitatively evaluated. Tables 5-142 and 5-143 list the COPCs and their associated media.

Current/Future On-site Laborer. As summarized in Table 5-181, the summed HI for all pathways does not exceed unity (one) and ranges from 2.5E-02 to 3.9E-05 for the RME and CTE scenarios, respectively. The driving pathway is dermal contact with surface soil (70 percent) for the RME scenario and ingestion of surface soil (50 percent) for the CTE scenario. The sole contributor to the risk estimates is chromium.

Future On-site Adult Resident. As summarized in Table 5-182, the summed HI for all pathways does not exceed unity (one) and ranges from 8.1E-02 to 1.3E-02 for the RME and CTE scenarios, respectively. The driving pathway is dermal contact with surface soil (48 percent) for the RME scenario and ingestion of produce (57 percent) for the CTE scenario. The sole contributor to the risk estimates is chromium.

Future On-site Child Resident. As summarized in Table 5-183, the summed HI for all pathways does not exceed unity (one) and ranges from 1.1E-01 to 2.8E-02 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of surface soil, which is greater than 43 percent of the total risk estimate. The sole contributor to the risk estimates is chromium.

Future Construction Worker. As summarized in Table 5-184, the summed HI for all pathways does not exceed unity (one) and ranges from 2.0E-02 to 3.4E-03 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of surface soil, which is greater than 74 percent of the total risk estimate. The sole contributor to the risk estimates is chromium.

SWMU 23 as a Whole. The general process used to select the COPCs associated with SWMU 23 as a whole described in Section 3.1.1. COPC selection for SWMU 23 is described

in Section 5.5.4.2. For current and future land use scenarios, cadmium, chromium, lead, anthracene, phenanthrene, pyrene, PCBs, and total c-PAHs were identified as COPCs. All COPCs were evaluated for systemic effects with the exception of lead, phenanthrene, and total carcinogenic PAHs. Noncarcinogenic inhalation toxicity information was not available at this point in time; therefore, the inhalation of particulates pathway was not quantitatively evaluated. Table 5-151 lists the COPCs and their associated media.

Current/Future On-site Laborer. As summarized in Table 5-185, the summed HI for all pathways does not exceed unity (one) and ranges from 4.7E-02 to 2.8E-04 for the RME and CTE scenarios, respectively. The driving pathway is dermal contact with surface soil (59 percent) for the RME scenario and ingestion of surface soil (64 percent) for the CTE scenario. The major contributor to the risk estimates is chromium.

5.5.4.7.3 *Characterization of Hazards Associated with Exposures to Lead*

Current Off-site Child Resident. The USEPA has developed the IEUBK model to evaluate lead exposure in children. The model estimates blood lead levels resulting from all applicable routes of exposure. The agency has set a target blood lead level of 10 μg Pb/dL blood. The IEUBK model was run for potential off-site residential exposures to resuspended lead-containing particulate. All defaults in the model were maintained with the exception of the input air concentration and the parameters—time spent outdoors, 3 hours/day, and lung absorption rate, 50 percent (see Appendix L). The air concentration input value is the boundary line concentration based on an average lead concentration resulting from the air dispersion modeling (Appendix N). Predicted mean blood lead levels ranged from 4.5 μg Pb/dL blood for children aged 1 to 2 years down to 2.7 μg Pb/dL blood for children aged 6 to 7 years. Mean blood lead level for the age span 0 to 7 years is 3.7 μg Pb/dL blood, which is below the USEPA target blood lead level of 10 μg Pb/dL blood.

Future On-site Child Resident. The IEUBK model was run for potential future on-site residential exposures to lead in soil, produce, air, and drinking water. All defaults in the model were maintained except the input air, soil, and produce concentrations and the parameters—time spent outdoors, 3 hours/day, and lung absorption rate, 50 percent (see Appendix L). The input air value is the boundary line concentration based on an average lead concentration resulting from the air dispersion modeling (Appendix N). Lead concentrations in soil and produce are based on an average EPC for lead. Predicted mean blood lead levels ranged from 5.0 μg Pb/dL blood for children aged 1 to 2 years down to 3.0 μg Pb/dL blood for children aged 6 to 7 years. Mean blood lead level for the age span 0 to 7 years is 4.11 μg Pb/dL blood, which is below the USEPA target blood lead level of 10 μg Pb/dL blood. Soil and dust uptake is the driving pathway, contributing greater than 53 percent of the total blood lead level.

Occupational exposure to lead is not evaluated because the future on-site child resident and current off-site child resident scenarios lead to acceptable blood lead levels and, therefore, provide a sufficient upper bound for on-site risk to encompass occasional use by military or civilian personnel in the course of their duties.

5.5.4.8 *Risk Assessment Summary and Conclusions*

A baseline risk assessment was conducted for the Bomb and Shell Reconditioning Building (SWMU 23) based on Phase I and Phase II RI data. Four current- and future-use scenarios were quantitatively evaluated:

- On-site laborer/security worker
- Off-site resident (inhalation only)
- On-site residents (redevelopment)
- Construction worker (during redevelopment)

For the current/future on-site laborer/security worker, all scenarios were found to fall within or below the target risk range of 10^{-4} to 10^{-6} for the ILCR and unity (one) for the total HI (see Tables 5-186 and 5-187).

The total ILCRs for both adult and child on-site residents ranged from 8.4E-03 to 2.7E-05 and 1.0E-03 to 1.2E-06 for the RME and CTE scenarios, respectively. The total HIs for both adult and child on-site residents ranged from 6.5E+00 to 2.8E-02 and 4.0E-03 to 1.8E+00 for the RME and CTE scenarios, respectively. The driving pathways include ingestion of produce, ingestion of surface soil, and dermal contact with surface soil.

In every instance where ILCR exceeded the upper bound of the acceptable range or HI exceeded one, the responsible pathway is ingestion of produce. Furthermore, each instrance is related to a PCB hot-spot. If home gardening was not part of the residential scenario, all risks would be within or below acceptable ranges. It should be remembered that any estimate of risk is dependent on the concurrent validity of all assumptions used to construct the exposure model. In other words, the estimates rely on several activities recurring with constant intensity and in predictable order. For example, produce ingestion assumes a constant consumption rate every day for durations up to 30 years for adults and 18 years for children. Food-chain pathways (i.e., home gardening) are significant contributors to total risks. According to Lee Sherry, a home economist with the Utah State University Agricultural Extension Service in Tooele, saline content in area soils generally require home gardeners and landscapers to replace or augment the existing soil with new topsoil. The above observation is confirmed by soil testing results from the Utah State University Soil Testing Laboratory (Appendix G).

Another major factor in the risk analysis is the method proposed by USEPA (1989a) for estimation of a dermal slope factor based on oral absorption. Nonlipophilic chemicals (e.g., inorganic salts) are poorly absorbed (USEPA 1992c) and seldom present significant risk via this route of exposure. Dermal exposure assessment guidance (USEPA 1992c) does not include quantitative evaluation of this pathway for metals. As a result, estimates for dermal absorption risk from inorganics are likely to be overstated.

Due to a lack of verified toxicity data for lead, potential systemic effects for that metal were quantitatively evaluated based on USEPA's Integrated Exposure Uptake Biokinetic Model (USEPA 1994) for lead in children. The model estimates blood lead levels resulting from all

Table 5-186. Summary of CTE Risk Results for SWMU 23

	Building 1343 Outfall		Outfall Near Building 1344		Building 1345 Outfall			Asphalt and Stained Area		SWMU as a Whole		
Scenario	HI	ILCR	HI	ILCR	HI	ILCR	Blood Lead Levels (μg Pb/dL Blood)	HI	ILCR	HI	ILCR	Blood Lead Levels (μg Pb/dL Blood)
Current Land Use												
On-site Laborer	1.2E-04	5.1E-09	2.3E-05	4.6E-09	6.5E-03	4.2E-08	---	3.9E-05	4.6E-09	2.8E-04	6.2E-09	---
Off-site Child Resident	---	---	---	---	---	---	---	---	---	---	---	3.70
Future Land Use												
On-site Adult Resident	7.4E-01	1.2E-05	1.2E-01	2.5E-06	3.9E+01	6.3E-04	---(a)	1.3E-02	1.2E-06	---	---	---
On-site Child Resident	1.2E+00	2.2E-05	1.9E-01	5.3E-06	6.3E+01	1.0E-03	4.10	2.8E-02	3.1E-06	---	---	---
Construction Worker	1.5E-03	5.8E-07	1.6E-02	5.8E-06	6.4E-03	7.2E-07	---	3.2E-03	1.2E-06	---	---	---

[a]Per EPA Guidance, the IEUBK model is designed for the child receptor, who is the most sensitive receptor. Therefore, blood levels for the adult receptor were not quantified.

Table 5-187. Summary of RME Risk Results for SWMU 23

	Building 1343 Outfall		Outfall Near Building 1344		Building 1345 Outfall			Asphalt and Stained Area		SWMU as a Whole		
Scenario	HI	ILCR	HI	ILCR	HI	ILCR	Blood Lead Levels (μg Pb/dL Blood)	HI	ILCR	HI	ILCR	Blood Lead Levels (μg Pb/dL Blood)
Current Land Use												
On-site Laborer	1.6E-02	1.9E-06	9.1E-03	1.3E-06	9.7E-01	4.6E-05	---	2.5E-02	1.3E-06	4.7E-02	3.2E-06	---
Off-site Child Resident	---	---	---	---	---	---	---	---	---	---	---	3.70
Future Land Use												
On-site Adult Resident	2.6E+00	1.6E-04	4.2E-01	3.7E-05	1.4E+02	8.4E-03	---(a)	8.1E-02	2.7E-05	---	---	---
On-site Child Resident	2.9E+00	1.1E-04	4.7E-01	3.1E-05	1.5E+02	5.6E-03	4.10	1.1E-01	3.1E-05	---	---	---
Construction Worker	7.1E-03	7.7E-06	9.3E-02	7.6E-05	3.5E-02	9.5E-06	---	2.0E-02	1.6E-05	---	---	---

[a]Per EPA Guidance, the IEUBK model is designed for the child receptor, who is the most sensitive receptor. Therefore, blood levels for the adult receptor were not quantified.

applicable routes of exposure. The agency has set a target blood lead level of 10 μg Pb/dL blood. For the inhalation of particulates pathway for the current off-site child resident, a mean blood lead level of 3.7 μg Pb/dL for the age span 0 to 7 years was estimated, which is below the USEPA target blood lead level of 10 μg Pb/dL blood. Predicted mean blood lead levels ranged from 5.0 μg Pb/dL blood for children aged 1 to 2 years down to 3.0 μg Pb/dL blood for children aged 6 to 7 years. Mean blood lead level for the age span 0 to 7 years is 4.11 μg Pb/dL blood, which is below the USEPA target blood lead level of 10 μg Pb/dL blood. Occupational exposure to lead is not evaluated because it is assumed that the future on-site child resident and current off-site child resident scenarios provide a sufficient upper bound for on-site risk to encompass occasional use by military personnel for weapons testing.
All scenarios for the future construction worker were found to fall within or below the target risk range of 10^{-4} to 10^{-6} for the ILCR and unity (one) for the total HI (see Tables 5-186 and 5-187).

When site-specific conditions are considered along with the conservative assumptions designed to offset assessment uncertainties, the risk estimates for the future residential scenario are, in point of fact, likely to be overestimated. Under the current BRAC, SWMU 23 is not included in the parcel for potential release for private redevelopment. The mission of SWMU 23 is assumed to continue into the indefinite future. Based on the available analytical data and the above considerations, the risk assessment results indicate that there is no immediate and substantial danger to human health from the presence of low levels of hazardous chemicals at SWMU 23.

5.5.5 Conclusions and Recommendations

During the summer of 1994, the Bomb and Shell Reconditioning Building (SWMU 23) Phase II field investigation was conducted to further characterize the nature and extent of contamination detected during the Phase I investigation. The Phase II sampling effort consisted of surface and subsurface soil sampling for metals, SVOCs, cyanide, and pesticides/PCBs. Phase II results confirmed the presence of previously identified cyanide, PCBs, SVOCs, and metals exceeding respective background values in the soils surrounding the SWMU. The source of the VOCs detected in headspace readings at two soil boring locations is unknown and a data gap appears to exist. Further evaluation of the nature and extent of this suspected VOC contamination should be conducted during the FS prior to final selection of remedial action alternatives for SWMU 23.

A baseline human health risk assessment was conducted at this SWMU to determine any potential human health risks associated with the no-action alternative. COPCs were evaluated in both the surface and subsurface soil data from the Phase I and Phase II investigations. In the Building 1343 Outfall Area, PCB 1254 was retained as a COPC. For the Building 1344 Outfall area, chromium, PCB 1254, and the total c-PAHs were retained as COPCs. The Building 1345 Outfall Area has cadmium, chromium, lead, anthracene, phenanthrene, pyrene, total PCBs, and total c-PAHs retained as COPCs. In addition, the Asphalt and Stained Area had chromium, and total c-PAHs retained. SWMU-wide exposure was assessed using the

COPCs anthracene, cadmium, chromium, lead, PCBs, phenanthrene, pyrene, and total c-PAHs.

Risk results for each of the areas of concern and the SWMU as a whole indicate that all current scenario carcinogenic risks are within or below the USEPA target range of 1E-04 to 1E-06. ICLRs for the future on-site adult and child resident exceed the target range at the Building 1345 Outfall and Building 1343 Outfall due primarily to ingestion of produce containing PCBs. Risks to the future construction worker were at acceptable levels for all of the areas of SWMU 23.

For noncarcinogenic hazards, the results for individual areas of concern indicate that there are no current scenario HIs exceeding the regulatory goal of unity (one). For future land use scenarios, the HIs for the adult and child future residents exceed the goal of unity at the Building 1345 Outfall and Building 1343 Outfall areas of concern primarily due to ingestion of produce. No other areas of concern had HIs exceeding the regulatory goal.

Ecological risk results for SWMU 23 are presented in the SWERA (Rust E&I 1996).

These risk assessment results indicate that risks to human health under current land use scenarios from the presence of low levels of hazardous chemicals at SWMU 23 are at acceptable levels when compared with risk-based criteria. Risks to future on-site residents exceed criteria for both RME ILCRs and HIs at the Building 1343 Outfall and Building 1345 Outfall areas of concern. Consideration should be given to doing hot spot removals at the stained areas associated with the outfalls and asphalt area because of the SVOCs and PCBs detected. It is recommended that no further remedial investigations are necessary. A feasibility study will be conducted for SWMU 23, as required by CERCLA, to determine if any other remedies are required for this SWMU. Conclusions from this report and the SWERA will be used during the FS process to derive final recommendations for SWMU 23.

5.6 OLD BURN STAGING AREA (SWMU 36)

5.6.1 Site Characteristics

The Old Burn Staging Area (SWMU 36) consists of a small gravel pit, which is located immediately north of the Old Burn Area (see Figure 1-2). SWMU 36 was used to store items that were to be burned or disposed of at the Old Burn Area. EPIC photographs show dark areas on the floor of the gravel pit, which were previously interpreted as areas of standing liquid. It was also suspected that trenching may have occurred in the bottom of the pit. Rust E&I conducted a geophysical survey in the pit to determine if buried materials were present. There were no target areas identified by the survey. However, during the Phase I RI field investigation, it was observed that several dark stained areas were present in the pit as a result of surface burning. Similar burned soils were found in a disturbed area north of the gravel pit.

5.6.2 Previous Investigations and Phase I and Phase II RI Activities

EPIC photographs from 1953 show what was interpreted to be three short trenches containing dark material covering the floor of the pit; photographs from 1959 show dark mounded material in the bottom of the pit; and photographs from 1966 show this dark material around the perimeter of the pit interpreted to be standing liquid. On the basis of the EPIC photographs and observations made during the site visit by Rust E&I in October 1991, it appears that the dark areas observed on the photographs represent surface burn areas rather than liquid or trenches as they were first interpreted to be. These burn areas were further defined during the Phase I RI field activities.

To confirm whether or not trenching had taken place in the pit, geophysical surveying of the pit was conducted during the Phase I field activities (Figure 5-20). The results of the survey indicated that trenching had not been done within the pit. Surface soil sampling conducted during the Phase I RI field activities at this SWMU is shown in Figure 5-20. These areas were targeted from the dark areas on the EPIC aerial photographs. These samples were analyzed for explosives, SVOCs, metals, and anions. Photographs of the pit area are included in Appendix C.

During the October 1991 site visit by Rust E&I, scrap metal, wood, and charred wood were observed scattered in a disturbed area just to the north of the staging area pit. A geophysical survey was conducted across these areas during the Phase I RI field activities to determine whether there was evidence of former trenches or pits, or whether the area was just used for surface burning. On the basis of the geophysical survey results (see Appendix F), it appears that the area was used for burning wooden boxes, crates, etc. on the ground surface only. Surface soil samples were collected from the areas containing surface debris, and the samples were analyzed for explosives, SVOCs, metals, and anions.

Phase I RI analytical results indicated elevated metals concentrations of barium (ranging from 400 to 580 μg/g), copper (ranging from 150 to 2,300 μg/g), lead (ranging from 1,200 to

1,900 μg/g), and zinc (ranging from 370 to 1,500 μg/g) in samples OSS-92-05, OSS-92-06, and OSS-92-13. Additionally, chromium at a concentration of 37.1 μg/g was detected in OSS-92-10; lead at a concentration of 21 μg/g was detected in OSS-92-11; and silver at a concentration of 1.7 μg/g and chromium at 22.3 μg/g were detected in OSS-92-13. No explosives were detected in the Phase I samples. Di-n-butyl phthalate was detected at low concentrations (less than 1 ppm) in samples OSS-92-06 and OSS-92-13 (up to 0.055 μg/g).

In July 1994, further investigation of the former burn areas in the gravel pit and north of the gravel pit was performed as a Phase II RI field investigation to determine the vertical and horizontal extent of metals contamination. A total of 16 surface soil samples were collected at locations selected on the basis of Phase I RI data. The amount of vertical migration of the metals contamination in these areas was to be assessed by six soil borings, four completed in the gravel pit and two north of the gravel pit. These proposed soil borings were replaced by test pits that were excavated by backhoe since the coarse gravel and cobbles inhibited the drilling. The test pits were excavated to a depth of 5 feet with samples collected at 0 to 6 inches, 3 feet, and 5 feet. All 16 surface and 18 test-pit samples (six of the samples are surface samples) at the Old Burn Staging Area were analyzed for metals only. Metal and wood debris was still scattered across the surface of the former gravel pit as well as around the area north of the pit. No burn surfaces were uncovered in the test pits within the gravel pit. North of the former gravel pit there was an area of sparse vegetation where burned shell casings and munitions debris were present on the surface (Figure 5-21). Three surface soil samples and two test pits were located in the vicinity of the disturbed area. In test pit OSP-94-06, a burn pit was uncovered containing mostly metal debris about 1 foot beneath the ground surface. This test pit cut across the mound of disturbed soil. The other test pits revealed native, undisturbed soils below the surface.

5.6.3 Contamination Assessment

5.6.3.1 *Data Evaluation*

This section evaluates the analytical data for its usability in the risk assessment. A data evaluation was performed by reviewing the data quality codes assigned by the USAEC Chemistry Branch and EcoChem, an independent third-party validator. In an effort to ascertain the level of certainty/uncertainty, USEPA data qualification codes were then assigned as an aid in interpreting the data for use in the risk assessment. (Table 2-4 defines the relationship between the USAEC Chemistry Branch codes and USEPA data qualifiers.) The following sections summarize the results of this process.

5.6.3.1.1 ***Field Duplicates.*** The "D" flag code represents a field duplicate. All "D" flagged data were compared with the primary investigative result, and the highest of the two values was used in the quantitative risk assessment.

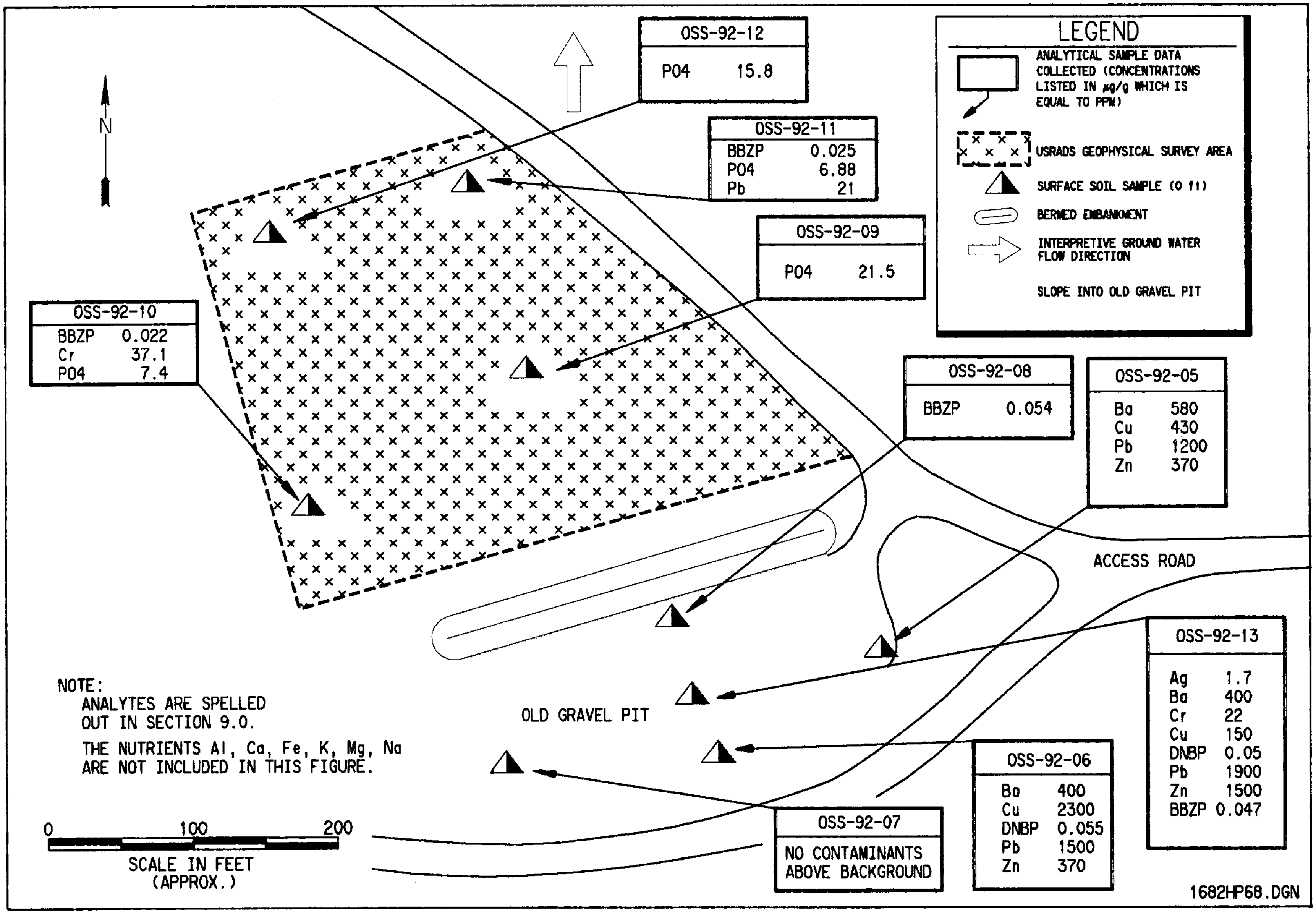

Figure 5-20. SWMU 36 Phase I Geophysical Survey Area, Sample Locations, and Results

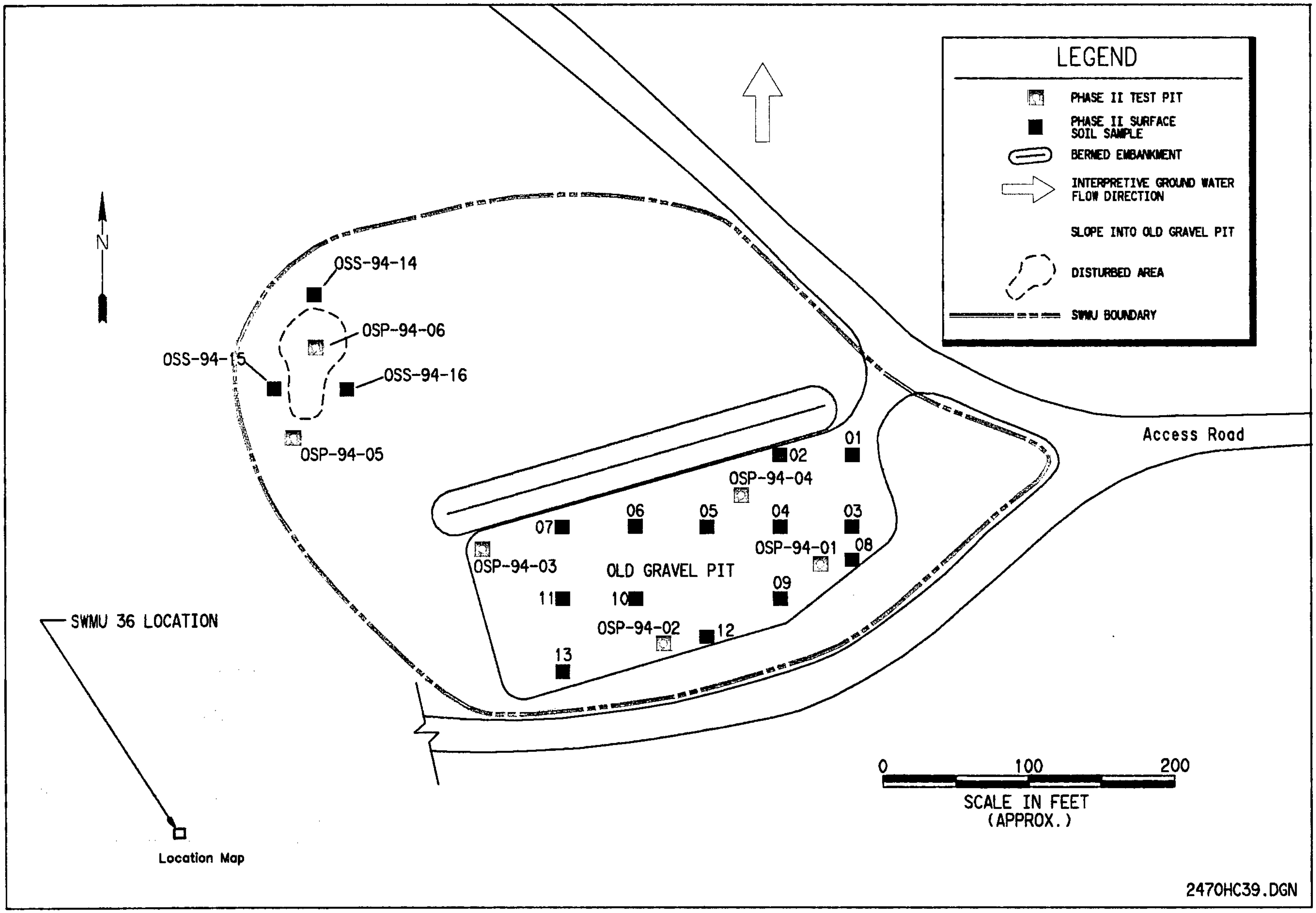

Figure 5-21. SWMU 36 Phase II Sample Locations

5.6.3.1.2 ***Blank Assessment.*** The USEPA has determined that when blank contamination exists, the investigative results must exceed the blank result by a factor of 5 (all compounds) or 10 (common laboratory contaminatants such as acetone) in order to be considered positive. Butylbenzyl phthalate and several metals were detected in method and or rinsate blanks associated with SWMU 36 soil samples. Based on comparisons to blanks, positive results were changed to nondetects for the following samples. According to USEPA guidance (USEPA 1989), the associated blank concentration was considered the quantitation limit for the affected samples.

- Surface Soil
  -Butylbenzyl phthalate—OSS-92-05 and -06
  -Aluminum—OSP-94-01A, -02A, -04A, OSS-04-01, -02, -04, -05, -07, -08, -09 (and duplicate), -10, and -12
  -Barium—OSP-94-01A, -02A, OSS-94-08, and -10
  -Chromium—OSS-94-01, -02, -05, -08, -09 (and duplicate), and -10.
  -Iron—OSP-94-01A, -04A, OSS-94-01, and -10
  -Manganese—OSP-94-01A, -02A, -03A, -04A, OSS-94-01, -05, -09, and -10
  -Nitrate—all nine 1992 samples (OSS-92-05 through -13)
  -Potasssium—OSP-94-01A, -02A, -03A, -04A, OSS-94-01, -02, -04, -05, -07, -08, -09 (and duplicate), -10, and -12
  -Vanadium—OSP-94-01A, -02A, -03A, -04A, OSS-94-01, -02, -04, -05, -06, -07, -08, -09 (and duplicate), -10, -11, and -12

- Subsurface Soil
  -Aluminum—all samples <u>except</u> OSP-94-05B
  -Barium—all samples <u>except</u> OSP-94-05B and -06B
  -Chromium—OSP-94-05C
  -Iron—all samples <u>except</u> OSP-94-05B and -06B
  -Manganese—all samples <u>except</u> OSP-94-05B
  -Potassium—all samples <u>except</u> OSP-94-05B
  -Vanadium—all samples
  -Zinc—OSP-94-05B, -05C, -06B, and 06C

5.6.3.1.3 ***USAEC Chemistry Branch Validation.*** The USAEC Chemistry Branch reviewed the analytical data for technical deficiencies based on the *USATHAMA (USAEC) Quality Assurance Program (PAM 11-41)*. USAEC data qualifiers assigned by the Chemistry Branch would be an indication of QC recoveries outside of USAEC control limits and other technical deficiencies. Estimating the data for use in the risk assessment based on USAEC data qualifiers is judged to be a conservative approach since USAEC control limits are generally narrower than USEPA Functional Guidelines. For SWMU 36, all data were accepted for use without qualification.

Non-Certified Compounds. USAEC flag codes of R or T were assigned by the analytical laboratory to indicate non-detected compounds that had not been performance demonstrated or

validated under the USAEC's 1990 QA program. Under this program a distinction is made between "target" and "non-target" analytes. "Target" compounds are determined during the certification process, and CRLs for these analytes are established. "Non-target" compounds are those that were added to the method to meet project-specific requirements. The lowest calibration standard typically reflects the PQL for that analyte. For the purpose of the risk assessment, the detection limit was assigned a J-code, due to the uncertainty associated with not having undergone a rigorous certification process.

5.6.3.1.4 ***Independent Third-Party Data Validation.*** A data quality assessment was completed using a validation effort by EcoChem, an independent third party. EcoChem's review and recommendations were based on USEPA Functional Guidelines as well as the *USATHAMA (USAEC) Quality Assurance Program (PAM 11-41)* and individual methods. All USEPA data qualifiers recommended by EcoChem were incorporated for use in the risk assessment and are provided in the analytical summary tables of Appendix J.

For SWMU 36, EcoChem evaluated one lot of arsenic analyses of soil samples by Method B9 and one lot of ICP-metal analyses of soil samples by Method JS12.

For the arsenic analyses, Lot ANWH, EcoChem found all results acceptable for use without qualification.

For the ICP-metals analyses, Lot ANWJ, EcoChem rejected (R) all antimony detection limits due to 0 percent recovery in the MS/MSD, indicating the possibility of false non-detects. Vanadium results less than the high spike concentration (30 μg/g) were qualified (J) due to low spike recovery and should be considered biased low.

Listed below are the sample results rejected for use in the risk assessment.

- Surface Samples
  -Antimony—OSP-94-05A, -06A

- Subsurface Samples
  -Antimony—OSP-94-05B, -05C, -06B, -06C

5.6.3.1.5 ***Data Evaluation Summary.*** A total of 31 surface soil samples (and 1 duplicate) and 12 subsurface soil samples (and 1 duplicate) were collected in 1992 and 1994 from 6 test pits and 25 surface locations at SWMU 36. Subsurface samples were collected at depths of 3 and 5 feet. Phase I samples were analyzed for semivolatiles, anions, metals, and explosives. Phase II samples were analyzed for metals. Because of blank contamination, positive results for a number of metals were changed to nondetects. However, in every case, the detected value in the affected sample was below the background screening level for the metal. Therefore, this issue does not significantly impact the risk assessment results.

The following metals had reporting limits that exceeded their background screening values: antimony, cadmium, silver, and thallium. The high reporting limits for cadmium (1.2 μg/g) and silver (0.80 μg/g) were less than their respective ingestion and soil-to-air RBCs, however. Additionally, eight cadmium nondetects had a reporting limit of 0.42 μg/g, which did not exceed background. Silver was detected in nine samples, only one of which exceeded background. Therefore, this issue does not significantly impact the risk assessment results for these chemicals.

Antimony and thallium were not detected in soils at this SWMU. The antimony and thallium reporting limits exceed the ingestion RBCs for these metals. Additionally, four antimony nondetect results were rejected due to poor matrix spike recoveries. The magnitude and extent of antimony and thallium contamination may not be adequately characterized at this SWMU.

Over 99 percent of sample results were judged to be usable for risk assessment purposes. In general, the number of samples and the analytical parameter list appear to be sufficient to characterize the nature, extent, and potential magnitude of contamination at this SWMU with the exceptions as noted above. A summary of chemicals detected in at least one surface or subsurface sample at SMWU 36 is presented in Appendix J, including data qualifiers (as appropriate) according to USEPA functional guidelines.

5.6.3.1.6 *Background Screening.* The maximum concentrations of inorganic chemicals detected in soil at SWMU 36 were compared to the site-specific background screening values (see Section 2.6). Any inorganic chemical detected in at least one sample at a concentration higher than the background screening value was retained in the COPC database. Surface soil and subsurface soil were screened separately. The results of the background screening are shown in Table 5-188.

Based on this screening analysis, barium, cadmium, chromium, cobalt, copper, iron, lead, magnesium, potassium, silver, and zinc are the inorganic analytes that are considered potential contaminants at SWMU 36 in surface soil. In subsurface soil, mercury is the only potential inorganic contaminant.

The CRL for arsenic for the samples analyzed in 1992 ranged from 24 to 72 μg/g; these CRLs were higher than the background screening value for this metal (11.69 μg/g). Cadmium was detected in only one sample; however, the CRL for cadmium for the 1994 samples was 1.2 μg/g, higher than the background threshold value (0.847 μg/g). Silver was detected in all 1992 samples, but in none of the 1994 samples. The CRL for the 1994 samples (0.803 μg/g) exceeded the background threshold value for silver (0.66 μg/g). Thallium was not detected in any samples, but the thallium CRL exceeded the background threshold value (11.70 μg/g).

Table 5-188. Background Screening of Inorganic Chemicals Detected in Soil at SWMU 36

Chemical	Frequency of Detection[a]	Maximum Detected Value (µg/g)[b]	Site-specific Background Screening Value[c] (µg/g)	Exceeds Site-specific Background?
Surface Soil				
Aluminum	9/22	23,300	28,083	No
Arsenic	22/31	9.21	11.69	No
Barium	27/31	580	247	YES
Beryllium	6/31	0.989	1.46	No
Cadmium	1/31	1.59	0.847	YES
Calcium	22/22	70,000	114,483	No
Chromium	23/31	37.1	20.62	YES
Cobalt	9/22	7.4	6.94	YES
Copper	31/31	2,300	24.72	YES
Iron	27/31	54,000	22,731	YES
Lead	29/31	1,900	18.23	YES
Magnesium	22/22	14,400	7,062	YES
Manganese	15/22	482	698	No
Mercury	2/31	0.0535	0.0572	No
Nickel	24/31	14.4	17.40	No
Potassium	9/22	6,920	5,450	YES
Silver	9/31	1.7	0.66	YES
Sodium	22/22	332	337	No
Vanadium	7/22	27.5	28.39	No
Zinc	31/31	1,500	102.8	YES
Subsurface Soil				
Aluminum	1/12	6,820	28,083	No
Arsenic	11/12	4.33	11.69	No
Barium	2/12	64.2	247	No
Calcium	12/12	66,000	114,483	No
Chromium	11/12	11.7	20.62	No
Cobalt	3/12	3.32	6.94	No
Copper	3/12	7.21	24.72	No
Iron	2/12	9,540	22,731	No
Magnesium	12/12	4,310	7,062	No
Manganese	1/12	168	698	No
Mercury	1/12	0.0907	0.0572	YES
Nickel	12/12	5.58	17.40	No
Potassium	1/12	1,330	5,450	No
Sodium	12/12	236	337	No

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]Micrograms per gram.
[c]See Section 2.6.1.1 for an explanation of how the site-specific background screening values were calculated.

5.6.3.2 *Summary of Analytical Results*

The list of analytes detected in at least one surface or subsurface soil sample is provided in Table 5-189 for Phase I data and in Table 5-190 for Phase II data. The complete data set is contained in Appendix H.

5.6.3.3 *Nature and Extent of Contamination*

Of the five surface samples collected within the gravel pit during Phase I (see Figure 5-20), three samples showed evidence of contamination within metals above background concentrations. Lead in these samples ranged from 1,200 to 1,900 μg/g. These samples also had elevated levels of barium, copper, and zinc. Sample OSS-92-13, additionally, had elevated levels of silver, chromium, and iron. Butyl benzyl phthalate and di-n-butyl phthalate were detected at low concentrations in several samples. Only two metals were detected above background threshold values in the samples collected in the USRADS geophysical survey area north of the pit. Chromium was detected at a concentration of 37.1 μg/g in sample OSS-92-10, and lead was detected at a concentration of 21.0 μg/g in sample OSS-92-11.

Surface soil samples collected within the former gravel pit during Phase II (Figure 5-22) were found to contain elevated metals. Additionally, three of the four surface soil samples from the test pits were also found to contain elevated metals. Surface sample OSS-94-03, located near the eastern edge of the pit, contained above background concentrations of cobalt (7.4 μg/g), chromium (23.1 μg/g), copper (32.3 μg/g), lead (28.8 μg/g), magnesium (14,400 μg/g), potassium (6,920 μg/g), and zinc (105 μg/g). Sample OSS-94-04, also located in the eastern portion of the pit, contained cadmium (1.59 μg/g), copper (39.4 μg/g), lead (112 μg/g), iron (26,100 μg/g), and zinc (122 μg/g) in above background concentrations. Sample OSS-94-06, located in the northwestern portion of the pit, contained above background concentrations of zinc (122 μg/g), lead (34.6 μg/g), and magnesium (7,350 μg/g). OSS-94-07 was found to contain elevated concentrations of copper (27.4 μg/g) and lead (19.7 μg/g). Sample OSS-94-12, located on the surface at the southern edge of the pit, contained barium (262 μg/g), copper (139 μg/g), lead (1,400 μg/g), and zinc (172 μg/g) in above background concentrations. This sample contained the highest concentration of lead (1,400 μg/g) detected in Phase II samples at this SWMU.

Sample results for test pits within the former gravel pit (OSP-94-01, -02, -03, and -04) (Figure 5-22) were found to contain lead (ranging from 17.7 to 21.1 μg/g) and zinc (ranging from 15.4 to 108 μg/g) in excess of background concentrations in surface soils. Subsurface samples from these same four test pits contained below background concentrations of metals with the exception of one detection of mercury (0.091 μg/g) at a depth of 3 feet in OSP-94-04.

Surface- and subsurface-soil sampling in a mounded area of disturbed soils northwest of the former gravel pit (see Figure 5-22) shows that metals are within background concentrations with the exception of copper (25.3 μg/g) and lead (41.8 μg/g) in surface sample OSS-94-14, lead (25.1 μg/g) in surface sample OSS-94-16, and lead in the surface soil sample from test pits OSP-94-05 and OSP-94-06 (at 57.4 and 30.6 μg/g, respectively) (Table 5-190). No subsurface contaminants were detected in this area.

Table 5-189. *Summary of Analytes Detected in Soil for the Old Burn Staging Area (SWMU 36) - Phase I*

Group	Analytes	Background Concentrations	OBS-92-05 (0ft)	OBS-92-06 (0ft)	OBS-92-07 (0ft)	OBS-92-08 (0ft)	OBS-92-09 (0ft)	OBS-92-10 (0ft)	OBS-92-11 (0ft)	OBS-92-12 (0ft)	OBS-92-13 (0ft)
METALS	BARIUM	247.1	580*	400*	47	40	120	110	120	100	400*
	CHROMIUM	20.62	7.73	8.56	LT 3.9	LT 3.9	13.6	37.1*	12.6	16.2	22.3*
	LEAD	18.23	1200*	1500*	8.3	16	18	18	21*	16	1900*
	MERCURY	0.0572	LT 0.0259	LT 0.0259	LT 0.0259	LT 0.0259	LT 0.0259	LT 0.0259	0.0266	LT 0.0259	LT 0.0259
	SILVER	0.66	0.301	0.181	0.0352	0.0633	0.0763	0.0506	0.122	0.062	1.7*
	COPPER	24.72	430*	2300*	5.54	18.3	12.9	10.5	18.6	12.3	150*
	IRON	22731	15000	13000	5900	10000	16000	15000	15000	15000	54000*
	NICKEL	17.4	5.55	LT 2.46	LT 2.46	LT 2.46	LT 2.46	8.03	LT 2.46	LT 2.46	12.8
	ZINC	102.8	370*	370*	30	74	81	52	70	66	1500*
ANIONS	PHOSPHATE	N/A	ND 5	ND 5	ND 5	ND 5	21.5*	7.4*	6.88*	15.8*	ND 5
SEMIVOLATILES	BUTYLBENZYL PHTHALATE	N/A	0.25#	0.02#	ND 0.33	0.054*	ND 0.33	0.022*	0.025*	ND 0.33	0.047*
	DI-N-BUTYL PHTHALATE	N/A	ND 0.33	0.055*	ND 0.33	ND 0.33	ND 0.33	ND 0.33	ND 0.33	ND 0.33	0.049*

Note.- All values in μg/g (equal to ppm).
N/A = Not Applicable.
* = Organic analyte detected above CRL or MDL or detected inorganic analyte exceeding background.
LT = Analyte concentration is less than CRL , the CRL is posted next to the "LT".
ND = Analyte not detected above the MDL, the MDL is posted next to the "ND".
# = Analyte was detected in the associated blank in excess of the 5 or 10 times rule (as described in Section 3.1.1.1).

Table 5-190. *Summary of Analytes Detected in Soil for the Old Burn Staging Area (SWMU 36) - Phase II*

Surface Soil

Group	Analytes	Background Concentrations	OSP-94-01A (0.5ft)	OSP-94-02A (0.5ft)	OSP-94-03A (0.5ft)	OSP-94-04A (0.5ft)	OSP-94-05A (0.5ft)	OSP-94-06A (0.5ft)	OSS-94-01 (0.5ft)	OSS-94-02 (0.5ft)	OSS-94-03 (0.5ft)	OSS-94-04 (0.5ft)	OSS-94-05 (0.5ft)	OSS-94-06 (0.5ft)	OSS-94-07 (0.5ft)
METALS	ALUMINUM	28083	1410#	2930#	4360	2110#	14800	14300	2360#	3880#	23300	3890#	2140#	5150	2940#
	ARSENIC	11.69	3.8	3.27	4.13	4.63	5.57	5.1	4.04	5.19	6.51	7.32	4.41	4.91	4.59
	BARIUM	247.1	24.7#	41.9#	58.8	49.9	147	120	55.5	63.3	204	198	49.3	81.3	60.6
	BERYLLIUM	1.465	LT 0.427	LT 0.427	LT 0.427	LT 0.427	0.647	0.593	LT 0.427	LT 0.427	0.989	LT 0.427	LT 0.427	LT 0.427	LT 0.427
	CADMIUM	0.847	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	1.59*	LT 1.2	LT 1.2	LT 1.2
	CALCIUM	114483	65000	63000	40800	34900	5950	4830	40400	51900	43000	44100	42900	58000	40200
	CHROMIUM	20.62	3.14	4.8	6.72	3.73	18.2	17.1	4.34#	5.49#	23.1*	11.6	4.66#	9.2	8.03
	COBALT	6.94	LT 2.5	LT 2.5	LT 2.5	LT 2.5	4.99	4.67	LT 2.5	LT 2.5	7.4*	3.97	LT 2.5	LT 2.5	2.57
	COPPER	24.72	3.53	10.3	17.9	9.65	21.9	16.7	17.3	11	32.3*	39.4*	12.7	20	27.4*
	IRON	22731	5440#	6110	9100	4620#	15200	14000	5370#	7460	22800	26100*	6970	9870	14000
	LEAD	18.23	LT 7.44	20.9*	17.7	21.1*	57.4*	30.6*	20.3*	26.1*	28.8*	112*	31.1*	34.6*	19.7*
	MAGNESIUM	7061	6780	6450	6280	3820	4860	4470	4370	10200*	14400*	5500	4470	7350*	4390
	MANGANESE	698.3	94.1#	124#	146#	90.8#	369	339	109#	172	482	218	115#	177	155
	MERCURY	0.0572	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	3.8	4.15	5.83	3.96	8.05	7.14	LT 2.74	4.39	14.4	5.63	4.14	6.85	6.59
	POTASSIUM	5449	221#	614#	942#	409#	4040	3880	472#	913#	6920*	895#	288#	1180	589#
	SODIUM	337	92.2	116	171	229	328	292	70.2	94.9	332	119	88.7	185	116
	VANADIUM	28.39	4.94#	6.92#	8.16#	4.86#	22.6	21.9	5.63#	6.97#	27.5	7.79#	5.77#	13.4#	7.11#
	ZINC	102.8	15.4#	45.2	108*	38.5	78.2	66	31.8	39.1	105*	122*	52.3	122*	84.1

Group	Analytes	Background Concentrations	OSS-94-08 (0.5ft)	OSS-94-09 (0.5ft)	OSS-94-09(D) (0.5ft)	OSS-94-10 (0.5ft)	OSS-94-11 (0.5ft)	OSS-94-12 (0.5ft)	OSS-94-13 (0.5ft)	OSS-94-14 (0.5ft)	OSS-94-15 (0.5ft)	OSS-94-16 (0.5ft)
METALS	ALUMINUM	28083	2530#	1580#	1170#	2150#	5630	2710#	7350	12500	13300	11700
	ARSENIC	11.69	9.21	5.17	3.15	4.65	4.7	4.86	4.41	4.78	4.78	4.53
	BARIUM	247.1	42#	55.6	63.7	24.4#	63.7	262*	85.9	138	113	116
	BERYLLIUM	1.465	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	0.64	0.57	0.58
	CADMIUM	0.847	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2
	CALCIUM	114483	68000	70000	64000	58000	38600	70000	37000	7180	3840	4370
	CHROMIUM	20.62	5.73#	3.06#	3.06#	3.44#	8.39	6.77	8.52	15.7	15.7	18.2
	COBALT	6.94	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	2.92	4.35	4.48	4.98
	COPPER	24.72	13.1	4.95	5.12	5.93	9.71	139*	13.2	25.3*	13.4	14.7
	IRON	22731	11800	6810	6600	6070#	9490	10700	11900	15400	15200	15600
	LEAD	18.23	26.2*	8.91	12.6	LT 7.44	11.6	1400*	29.7*	41.8*	16.4	25.1*
	MAGNESIUM	7061	10800*	6930	6810	6470	6080	6380	6760	4770	4580	4660
	MANGANESE	698.3	196	101#	286	107#	166	170	230	377	358	362
	MERCURY	0.0572	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	0.0535
	NICKEL	17.4	6.89	4.53	6.53	4.51	5.88	5.84	6.13	8.56	8.64	9.18
	POTASSIUM	5449	629#	169#	158#	264#	1400	514#	1960	3410	3540	3140
	SODIUM	337	67.2	65.6	47.8	61.3	133	89.3	139	173	164	130
	VANADIUM	28.39	5.84#	5.53#	6.45#	5.54#	11.5#	6.92#	13.6	20	19.6	17.5
	ZINC	102.8	61.9	26.9	26.2	20.4	44	172*	63.2	76.1	52.4	57.6

Table 5-190. *Summary of Analytes Detected in Soil for the Old Burn Staging Area (SWMU 36) - Phase II (continued)*

Subsurface Soil

Group	Analytes	Background Concentrations	OSP-94-01B (3ft)	OSP-94-01C (5ft)	OSP-94-02B (3ft)	OSP-94-02C (5ft)	OSP-94-03B (3ft)	OSP-94-03C (5ft)	OSP-94-04B (3ft)	OSP-94-04C (5ft)	OSP-94-04C(D) (5ft)	OSP-94-05B (3ft)	OSP-94-05C (5ft)	OSP-94-06B (3ft)	OSP-94-06C (5ft)
METALS	ALUMINUM	28083	1280#	993#	1600#	877#	1450#	1050#	1760#	1670#	1460#	6820	3160#	5850#	1890#
	ARSENIC	11.69	3.56	LT 2.5	3.09	3.54	3.86	4.33	3.9	3.72	3.97	4.28	2.95	3.89	3.56
	BARIUM	247.1	28.5#	17.1#	29.4#	21.4#	34.6#	28.4#	37.3#	35.5#	30.1#	64.2	34.2#	56.9	32.6#
	CALCIUM	114483	45000	35700	63000	66000	45700	37200	43800	63000	44500	13700	29200	15000	42800
	CHROMIUM	20.62	3.65	2.55	3.78	2.99	3.14	2.52	2.94	4.23	3.66	9.3	6.95#	8.45	11.7
	COBALT	6.94	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	3.32	LT 2.5	3.26	2.62
	COPPER	24.72	LT 2.84	LT 2.84	LT 2.84	LT 2.84	LT 2.84	LT 2.84	LT 2.84	LT 2.84	LT 2.84	6.39	3.21	7.21	LT 2.84
	IRON	22731	5160#	3520#	4870#	4070#	4480#	3410#	4100#	4990#	5040#	9300	6790#	9540	7940#
	MAGNESIUM	7061	3640	2800	3870	3710	4090	3100	3910	4310	3750	2460	3620	2280	3760
	MANGANESE	638.3	87.7#	53#	91#	77.2#	80#	65.2#	77.8#	88.9#	72.5#	168	99#	142#	86.5#
	MERCURY	0.0572	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	0.0907*	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	4.22	3.39	4.43	3.77	3.69	3.62	3.47	4.1	3.69	5.58	3.17	5.43	3.93
	POTASSIUM	5449	261#	186#	322#	210#	297#	171#	223#	218#	230#	1330	456#	1040#	252#
	SODIUM	337	127	69.8	157	64.5	167	96.3	236	195	125	207	227	155	174

Note.- All values in μg/g (equal to ppm).

= Analyte was detected in the associated blank in excess of the 5 or 10 times rule (as described in Section 3.1.1.1).

LT = Analyte concentration is less than CRL , the CRL is posted next to the "LT".

* = Organic analyte detected above CRL or MDL or detected inorganic analyte exceeding background.

(D) = Duplicate analysis.

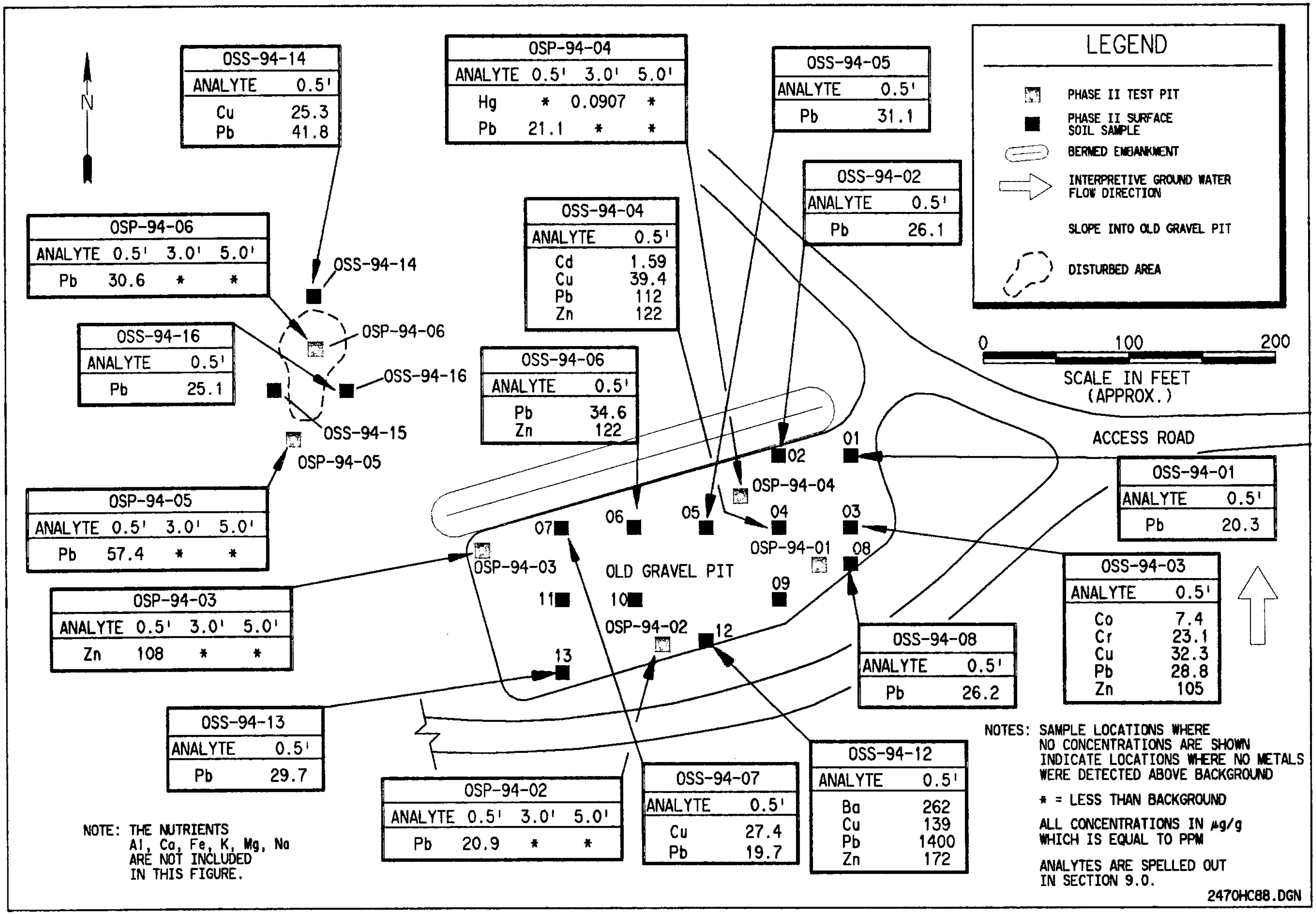

Figure 5-22. SWMU 36 Phase II Results

On the basis of both Phase I and Phase II results at SWMU 36, it is concluded that contamination at this SWMU is restricted to surface soil metals corresponding to identifiable areas of open burning within the staging area (former gravel pit) and to the north. The highest concentrations of metals correspond to areas where charred metal and wood debris and/or soil staining was observed at the surface. Test pit sample results show that vertical migration of surface contaminants has not occurred.

5.6.4 Human Health Risk Assessment

As part of the Phase II RI, an RA was conducted to estimate potential human health risks associated with the no-action alternative for SWMU 36, the Old Burn Staging Area. The following tasks were completed in the RA:

- Data analysis and selection of COPCs
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Conclusions and recommendations

This section provides a summary of the quantitative process employed at SWMU 36 and the results of that process. The RA for SWMU 36 is based on the methodology described in Section 3.1 and supported by Appendices L, M, N, and O.

5.6.4.1 *Selection of the Chemicals of Potential Concern—Soil*

As detailed in USEPA guidance (USEPA 1989a; USEPA 1994), a screening procedure can be used to narrow the list of contaminants at a particular site to a subset of analytes that can be considered the COPCs for the area. This screening procedure can involve up to four steps, depending on the contaminants present:

- Group data by chemical class (e.g., carcinogenic PAHs)
- Evaluate frequency of detection
- Evaluate essential nutrients
- Compare site data to risk-based screening concentrations (Region III values)

Below is the screening analysis for SWMU 36.

5.6.4.1.1 ***Data Grouping.*** No data grouping was necessary as part of COPC selection at SWMU 36.

5.6.4.1.2 ***Frequency of Detection.*** Cadmium was the only chemical detected in fewer than 5 percent of surface soil samples. This metal was detected in 1 of 31 samples (3 percent). However, the CRL for cadmium in all the nondetect samples was 1.2 μg/g, which exceeds the background screening value of 0.847 μg/g for this metal. Cadmium has also been detected at concentrations above background at other SWMUs where similar activities have taken place. Therefore, cadmium was retained in the surface soil database. Since the maximum number of subsurface samples was 12, there were too few samples to eliminate chemicals based on frequency of detection.

5.6.4.1.3 ***Nutrient Screening.*** All of the nutrients detected above background in surface soil had maximum detected values that were less than their respective nutrient screening values: iron (maximum—54,000 μg/g; screening value—70,000 μg/g), magnesium (maximum—14,400 μg/g; screening value—1,000,000 μg/g), and potassium (maximum—6,920 μg/g; screening value—150,000 μg/g). Therefore, these nutrients were eliminated as COPCs in surface soil.

No nutrient chemicals were detected in subsurface soil above background screening values.

5.6.4.1.4 ***Region III RBC Screening.*** The final step in the COPC selection process consisted of comparing the EPCs for remaining contaminants in surface and subsurface soil with Region III RBCs. However, before these comparisons can be made, a "hot spot" analysis was conducted.

Hot Spot Analysis. For the final selection of COPCs, the SWMU was evaluated for possible "hot spots." For the purposes of the risk assessment, the data were divided into samples collected within the old gravel pit and samples collected from the area north of the pit. Within each of these two areas of concern, evaluation of the distribution of contamination revealed that the highest concentrations of lead and other potential COPCs occurred in the eastern portion of the pit, in an area about the size of a hypothetical 0.5-acre residential lot (see Figures 5-20 and 5-22). Therefore, the samples from that portion of the pit were segregated as a potential area of higher contamination. The sample locations included in this hot spot were as follows: OSS-92-05, -06, -07, and -08; OSP-94-01 and -04; OSS-94-01, -02, -03, -04, -05, -08, -09 and -12. The remaining test pit and surface soil samples from within the gravel pit (from seven locations in the western portion) were evaluated separately as a group. Contamination was minimal in the area north of the gravel pit. All samples from the area north of the pit were combined and evaluated separately as a group.

Table 5-191 provides a summary of the EPCs for preliminary COPCs in surface and subsurface soil at the designated areas of concern at SWMU 36.

Soil-related Exposure Pathways. To select COPCs for the soil-related exposure pathways, the EPCs for the areas of concern within the SWMU in surface and subsurface soil were compared

Table 5-191. Summary of Preliminary Chemicals of Potential Concern (SWMU 36)

Chemical	Frequency of Detection[a]	Range of Detected Values (µg/g)[b]	Range of Reporting Limits (µg/g)	Arithmetic Mean Concentration (µg/g)	95% UCL[c] Concentration (µg/g)	Exposure Point Concentration[d] (µg/g)
Gravel Pit Hot Spot - Surface Soil						
Barium	12/14	40.0 - 580	8.43 - 9.05	221	1,322	580
Cadmium	1/13[e]	1.59	0.42 - 1.20	0.589	0.860	0.860
Chromium	8/14	3.14 - 23.1	1.21 - 3.90	7.18	34.2	23.1
Cobalt	2/10	3.97 - 7.40	2.50	2.00	3.51	3.51
Copper	14/14	3.53 - 2,300	NA[f]	137	1,633	1,633
Lead	13/14	12.6 - 1,900	7.44	457	12,651	1,900
Silver	4/14	0.063 - 1.70	0.80	0.446	0.709	0.709
Zinc	14/14	15.4 - 1,500	NA	178	586	586
Butylbenzyl phthalate	2/4	0.047 - 0.054	0.09	0.048	0.053	0.053
Di-n-butyl phthalate	2/2[g]	0.049 - 0.055	NA	0.052	NA	0.055
Gravel Pit Hot Spot - Subsurface Soil						
Mercury	1/4	0.091	0.05	0.040	0.253	0.091
Gravel Pit - Outside of Hot Spot - Surface Soil						
Copper	8/8	5.54 - 27.4	NA	13.8	24.3	24.3
Lead	7/8	8.30 - 34.6	7.44	19.0	44.5	34.6
Zinc	8/8	20.4 - 122	NA	64.9	128	122
North of Gravel Pit - Surface Soil						
Chromium	9/9	12.6 - 37.1	NA	17.9	22.7	22.7
Copper	9/9	10.5 - 25.3	NA	16.2	20.0	20.0
Lead	9/9	16.0 - 57.4	NA	26.9	39.1	39.1
Butyl benzyl phthalate	2/2[f]	0.022 - 0.025	NA	0.023	NA	0.023

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]Micrograms per gram.
[c]Upper control limit.
[d]The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (USEPA, 1989).
[e]One sample was not included in the calculations due to a high CRL.
[f]Not applicable.
[g]Two samples were not included in the calculations due to high CRLs.

to Region III soil ingestion and soil-to-air RBCs. As shown in Table 5-192, three chemicals were retained as COPCs in the surface soil at the hot spot within the gravel pit: barium, copper, and lead. Mercury was the only metal detected above background in subsurface soil within this area, but the EPC for mercury was less than the Region III screening RBCs.

Table 5-192 shows that copper, lead, and zinc were the only metals above background threshold values in the gravel pit in the area outside of the hot spot, but none of these was retained as a COPC. No chemicals were detected above background in the subsurface soil within this area.

Chromium, copper, and lead were detected above background in the area north of the gravel pit, and butyl benzyl phthalate was detected in two of four samples. The EPCs for these chemicals, however, were less than their respective Region III RBCs. No chemicals were detected above background in the subsurface soil samples collected north of the pit.

5.6.4.1.5 ***Site-wide Soils.*** Concentrations of the COPCs for surface soils—barium, copper, and lead—were calculated on a site-wide basis for the purpose of evaluating site-wide exposure scenarios. Site-wide concentrations were calculated utilizing all surface soil samples collected at SWMU 36. The site-wide concentrations of these surface soil COPCs are provided in Table 5-193.

5.6.4.2 *Selection of Chemicals of Potential Concern-Air*

For all receptors with the exception of the construction worker, the air pathway (i.e., inhalation of particulates) is evaluated on a SWMU-wide basis rather than by area of concern. Because all COPCs in soils were either metals or semi-volatile organics with very low volatility, potential exposures to wind-blown particulate would be contributed to by the entire SWMU (as well as exposed soil outside the defined SWMU), regardless of the specific SWMU-related activity. This was also assumed for potential off-site receptors. Air emissions of SWMU-related chemicals were assumed to occur by entrainment from wind erosion of particulate-bound COPCs. With entrainment, it is assumed that small amounts of the organic compounds or heavy metals become airborne and adsorbed onto the surface of dust particles.

A volatilization emission analysis was performed (SEC Donahue 1992b) using a volatilization release estimation equation designed for chemicals spilled or incorporated into soils (USEPA 1988a). Results from this analysis indicated negligible air quality impacts derived from volatilization releases from SWMUs located at TEAD. In addition, results from previous modeling conducted for adjacent sites with similar VOC concentrations revealed insignificant releases (SEC Donahue 1992b).

For current and future on-site receptors, COPCs retained for the soil pathways were used to evaluate exposures from air. For current off-site receptors, exposure point concentrations generated for COPCs retained for the on-site soil pathways were modeled using SCREEN2 to

Table 5-192. Selection of Chemicals of Potential Concern for Soil-related Pathways Based on EPA Region III's RBCs (SWMU 36)

	EPA[a] Region III RBC[b] Screen			
	Residential RBCs (μg/g)[c]			
Chemical	**Ingestion**	**Inhalation**	**Exposure Point Conc. (μg/g)**	**Retained as COPC?[d]**
Gravel Pit Hot Spot - Surface Soil				
Barium	550	35,000	580	**YES**
Cadmium	3.9	920	0.860	No
Chromium	39	140	23.1	No
Cobalt	470	NA[e]	3.51	No
Copper	310	NA	1,633	**YES**
Lead	400[f]	NA	1,900	**YES**
Silver	39.0	NA	0.709	No
Zinc	2,300	NA	586	No
Butyl benzyl phthalate	1,600	53	0.053	No
Di-n-butyl phthalate	780	10	0.055	No
Gravel Pit Hot Spot - Subsurface Soil				
Mercury	2.3	0.7	0.091	No
Gravel Pit - Outside of Hot Spot - Surface Soil				
Copper	310	NA	24.3	No
Lead	400[f]	NA	34.6	No
Zinc	2,300	NA	122	No
North of Gravel Pit - Surface Soil				
Chromium	39	140	22.7	No
Copper	310	NA	20.0	No
Lead	40[f]	NA	39.1	No
Butyl benzyl phthalate	1,600	53	0.023	No

[a]U.S. Environmental Protection Agency.
[b]Risk-based concentrations were taken directly from the Region III RBC Table (US EPA, 1995), except as noted in the footnotes. Values for noncarcinogens are 1/10 of the Region III RBC.
[c]Micrograms per gram.
[d]Chemicals of potential concern.
[e] Not applicable; value could not be calculated.
[f]OSWER recommended clean-up level for lead in residential soil (USEPA 1995).

Table 5-193. Site-Wide Surface Soil Exposure Point Concentrations of Chemicals of Potential Concern (SWMU 36)

Chemical	Frequency of Detection[a]	Range of Detected Values (μg/g)	Range of Reporting Limits (μg/g)	Arithmetic Mean Concentration (μg/g)	95% UCL Concentration (μg/g)	Exposure Point Concentration[b] (μg/g)
Barium	27/31	40.0 - 580	8.4 - 9.1	154	309	309
Copper	31/31	3.53 - 2,300	NA[c]	47.0	100	100
Lead	29/31	8.30 - 1,900	7.4	117	344	344

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
[c]Not applicable.

estimate the air quality impacts at selected sites surrounding TEAD. To maintain a health-protective approach, the RME EPC for children was used as the input soil concentration to the model. Off-site air concentrations generated by the model were screened against USEPA Region III Risk-Based Concentrations guidance to verify the negligible contribution of this pathway. SCREEN2 is a single-source, screening-level model that has algorithms to estimate air quality impacts associated with air sources. For a complete description of the SCREEN2 model and associated results, see Appendix N. As shown in Table 5-194, based on comparison to air RBC, no COPCs were retained for quantitative off-site evaluation.

5.6.4.3 *Selection of the Chemicals of Potential Concern—Groundwater*

The selection of COPCs for the groundwater exposure pathways consist of a two-phase modeling approach. Initially, the *maximum* concentration of each analyte detected in either surface or subsurface soil was compared to the Region III soil-to-groundwater RBC. One-tenth of the value was used for noncarcinogens. If the maximum concentration of a chemical exceeded the soil-to-groundwater RBC, the chemical was selected for vadose zone modeling (Table 5-195). The modeled break-through concentration in groundwater for these chemicals was then compared to the Region III tap water RBCs, with one-tenth of the value used for noncarcinogens. In addition, the modeled break-through time was compared to the 100-year cut-off period as described in Section 2.7.2. A chemical that reached the water table within 100 years *and* had a modeled break-through concentration that exceeded the Region III tap water RBC (one-tenth of the value for noncarcinogens) was retained for further vadose-saturated zone modeling to on- and off-site hypothetical receptors as described in Section 2.7.2. For this second phase of modeling, the *average* surface and subsurface soil concentration was used to calculate the initial pore water concentration at the SWMU. Again, the vadose-saturated zone modeling results were compared to the Region III tap water RBCs, with one-tenth for noncarcinogens. If the chemical still failed to meet the 100-year break-through criteria *and* exceeded the Region III tap water RBC, it was retained for quantitative risk assessment. As shown in Table 5-195, barium, cadmium, chromium, copper, and lead were retained for vadose zone modeling.

5.6.4.3.1 ***Vadose Zone Model Results.*** The soil screening described in the previous sections indicated that five COPCs should be evaluated using the soil-vadose-zone-groundwater-screening model at SWMU 36. These COPCs consist of the five metals as shown in Table 5-195. The vadose-zone modeling set-up procedures are described in detail in Section 2.7.2 of this report. This section defines the site-specific parameters and presents the vadose-zone modeling results.

The SWMU 36 site-specific input parameters are defined as the thickness of the vadose-zone (H cm), the area of contamination (CA m^2), and the thickness of the contaminated zone (H cont, cm). These input parameters, along with the COPC chemical-specific parameters,

Table 5-194. Selection of Chemicals of Potential Concern for Off-site Air-related Pathways Based on EPA Region III's Risk-Based Concentration Screening Guidance (SWMU 36)

Chemical	RME SWMU-wide Soil Exposure Point Conc. (mg/kg)[c]	EPA Region III Risk-Based Concentration[a] Screen ($\mu g/m^3$)[b]					Retained as off-site COPC[d]?
		Exposure Point Conc. at Property Line	Exposure Point Conc. at Grantsville	Exposure Point Conc. at Tooele	Exposure Point Conc. at Stockton	Ambient Air RBC	
Barium	309	0.0033	0.00015	0.00019	0.00028	0.052	No
Copper	100	0.0011	0.000049	0.000061	0.000090	15	No
Lead	344	0.0036	0.00017	0.00021	0.00031	1.5[e]	No

[a]Values for noncarcinogens are 1/10th of the Region III RBC (USEPA 1996).
[b]Micrograms per cubic meter.
[c]Milligrams per kilogram.
[d]Chemicals of potential concern.
[e]National Ambient Air Quanlity Standard.

Table 5-195. Selection of COPCs for Groundwater Exposure Pathways (SMWU 36)

Chemical	Maximum Above Background (μg/g)[a]	Depth	Soil-to-GW[b] RBC[c] (μg/g)	Selected for Vadose Zone Modeling?	Reached the Water Table Within 100 Years	Model Output: Exposure Point Concentration in Groundwater mg/L[d]	Tap Water RBC mg/L	Selected as COPC[e] for Groundwater[f]
Barium	580	Surface	3.2	YES	No	0.041	0.260	No
Cadmium	1.59	Surface	0.6	YES	No	0.0039	0.0018	No
Chromium	37.1	Surface	1.9	YES	No	0.138	0.018	No
Cobalt	7.4	Surface	119[g]	No	---	---	---	---
Copper	2,300	Surface	31[g]	YES	No	3.31	0.140	No
Lead	1,900	Surface	15[g]	YES	No	0.497	0.015[h]	No
Silver	1.7	Surface	19[g]	No	---	---	---	---
Zinc	1,500	Surface	4,200	No	---	---	---	---
Butyl benzyl phthalate	0.054	Surface	6.8	No	---	---	---	---
Di-n-butyl phthalate	0.055	Surface	12.0	No	---	---	---	---

[a]Micrograms per gram.
[b]Groundwater.
[c]Risk-based concentrations were taken directly from the Region III RBC Table except as indicated in the footnotes.
[d]Milligrams per liter.
[e]Chemicals of potential concern.
[f]Eliminated as a groundwater COPC if the chemical reached the water table more than 100 years or did not exceed the tap water RBC.
[g]Calculated according to Region III guidance (USEPA 1995).
[h]Action level for lead (USEPA 1995).

are used as the input for the GWM-1 and MULTIMED models. An example of a GWM-1 spreadsheet model for SWMU 36 is shown in Appendix K. As the figure in Appendix K indicates, the site-specific parameters for SWMU 36 are as follows:

H = 8,200 cm

CA = 6,505 m^2

H cont = 152 cm

Other key COPC-specific parameters—the distribution coefficient (Kd), the maximum observed soil concentration (Tc), the initial pore water concentration (C_{init}), and the plume pulse duration (p.d.)—are also shown in Appendix K. All of the GWM-1 spreadsheets associated with the SWMU-specific COPCs are in Appendix K along with the MULTIMED output concentrations. Table 5-196 summarizes these COPC-specific parameters and shows the MULTIMED output for COPC break-through time (time after leaching starts, that the leading edge of the COPC plume reaches the top of the water table) along with the COPC estimated concentration at the time that breakthrough occurs. One key to interpreting these estimates is that the pore water concentration was determined by starting with the maximum observed soil concentration at the SWMU (see Table 5-196) and calculating the maximum concentration available for the pore water solution by soil-water partitioning. As explained in Section 2.7.2, the equation used is very dependent on Kd and does not take into account mineral solubility and equilibrium relationships. This is evident by some of the high C_{init} concentrations estimated for several of the COPCs.

5.6.4.3.2 ***Groundwater COPCs.*** As shown in the previous sections and in Table 5-196, the MULTIMED output indicates that within a 100-year time period none of the SWMU 36 COPCs will travel downward through the vadose zone and reach the water table. As discussed in detail in Section 2.7.2, the conservative approach was the basis for the model calculations.

Table 5-196 illustrates this concept, showing the critical input and output parameters and the estimated break-through time for each COPC. This table also shows the estimated concentration associated with the arrival of the leading edge of the COPC plume at the water table. Again, it should be noted that the break-through time calculation does not take into account the various retardation influences, such as biodegradation, volatilization, absorption, adsorption, and mineral-solution equilibrium relationships.

In summary, the COPCs ranged in break-through time from 800 years for chromium to 32,000 years for barium.

Table 5-196. Summary of Vadose Zone Break-Through Modeling Results and Critical I/O GWM-1 and MULTIMED Parameters for SWMU 36

COPC[a] Specific Parameters						
Analyte	**Kd[b]**	**Tc[c] (max) (ppm)[d]**	**C_{leak}[e] (mg/L)[f]**	**Breakthrough Time (yrs)**	**Breakthrough Conc. (mg/L)**	**p.d.[g] (yrs)**
Barium	52	580	12.4	32,000	0.041	1,364
Cadmium	1.3	1.59	1.25	850	0.0039	37
Chromium	1.2	37.1	31.4	800	0.138	34
Copper	1.3	2,300	1,690	900	3.31	40
Lead	4.5	1,900	458	2,750	0.497	121

Note.—Site-specific parameters are as follows: vadose zone thickness (H) = 8,200 cm; area of contaminated soil (CA) = 6,505 m^2; thickness of contaminated soil (Hcont) = 152 cm.

[a]Chemicals of potential concern.
[b]Distribution coefficient and is dimensionless.
[c]Maximum observed soil concentration (ppm).
[d]Parts per million.
[e]Pore water concentration at the source as conservatively calculated by GWM-1.
[f]Milligrams per liter.
[g]Pulse duration as calculated by GWM-1.

5.6.4.4 *Exposure Assessment*

Exposure is defined as the contact of a receptor with a chemical (USEPA 1989c). Exposure assessment is the estimation of the magnitude, frequency, and duration for each identified route of exposure. The magnitude of an exposure is determined by estimating the amount of chemical available at the receptor exchange boundaries (i.e., lungs, gastrointestinal tract, or skin) during a specified time period.

Section 3.1.2 describes the general tasks comprising the exposure assessment. The specific application of these tasks to SWMU 36 is described below.

5.6.4.4.1 ***Characterization of Exposure Setting*****.** The first step in developing exposure scenarios for SWMU 36 was to characterize the site setting in which potential exposures might occur. The characteristics of the site setting influence the types of transport mechanisms and the type of receptor exposure that could occur. The site setting also provides a basis for identifying the potential receptors (either real or, in the case of site redevelopment for alternative use, hypothetical). Both current land use patterns and future land use patterns were examined as part of the characterization.

Current Land Use**.** As is true for other areas of TEAD-N, public access to SWMU 36 is controlled, thereby precluding transient exposure. SWMU 36 is located in the south-central portion of TEAD-N and will remain part of the depot mission for the foreseeable future.

Based on the above information, potential receptors under current land use were defined as the SWMU-specific laborers and security personnel (e.g., individuals with job descriptions that call for repeated, light to moderate labor in the general vicinity of SWMU 36 and staff assigned to maintenance of the perimeter of security personnel that repeatedly work in the vicinity of SWMU 36).

Because other potential receptors would be exposed only intermittently to SWMU 36, SWMU-specific laborers and security personnel were the only on-site receptors evaluated quantitatively as a current-use scenario. This approach provides a series of upper-bound estimates.

Cattle grazing is permitted at TEAD-N, with grazing allotments competitively bid and leased every 5 years to a single rancher. The current lease is up for rebid in 1996. Grazing at TEAD-N typically occurs between October 15 and May 31, with calving taking place in January. The calves remain at the facility until May 31 when they are either moved to feedlots or to other grazing areas. The calves typically do not return to TEAD-N after their initial exposure, and they are eventually sold as slaughter cattle for human consumption. Distribution is through regional and national distribution networks. The cows are normally utilized as breeding stock and may or may not return to the site during consecutive years. The current lessee brings approximately 1,000 head, mostly heifers, to winter pasture at TEAD-N and maintains summer pasture in Idaho (M. Walker, personal communication with Rust E&I, 1994).

SWMU 36 is one of several SWMUs on one grazing allotment currently under lease. Consumption of beef grazed on the allotment of which SWMU 36 is a part is evaluated in a separate section (Section 5.7) of the risk assessment.

Future Land Use. No change in current use is planned for the Old Burn Staging Area. Current BRAC recommendations retain SWMU 36's function as part of the depot's mission. However, should the mission of TEAD-N change in the future, two additional exposure scenarios unique to planned or potential future use of SWMU 36 were developed (see Section 3.0):

- Skilled laborers—Individuals assigned to short-term construction in the vicinity of SWMU 36 during potential redevelopment.

- Inhabitants of an on-site residence(s)—Individuals who live in residences established at the time that depot property should ever be transferred for redevelopment.

5.6.4.4.2 *Characterization of Potential Exposure Pathways*. An exposure pathway is the route COPCs take to reach potential receptors. Section 3.1.2.1 and 3.1.2.2 describe the methodology for characterization of exposure pathways. This methodology was then applied to SWMU 36. The following sections describe the potential exposure pathways associated with SWMU 36 for the current and future land use scenarios.

Current Land Use. Currently, the majority of laborers at TEAD-N work 10-hour days with 4-day weeks. A total of 4 weeks off a year for vacation, holidays, and sick leave yields 192 days per year on the job. It is assumed that a laborer could be at any specific SWMU from 2 (CTE) to 10 (RME) hours per day and will incidentally ingest, inhale, or become in contact with surface soil through worker-related activities. Military personnel are rotated on assignment an average of every 3 years (S. Culley, personal communication with Rust E&I, 1994). If a laborer is a civilian, the length of assignment could be expected to range as high as 25 years. It is assumed that all of the exposure is from outdoor tasks or activities. Specific parameters relating to ingestion, contact, and ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

Future Land Use. No change in current use is planned for the Old Burn Staging Area. Current BRAC recommendations retain SWMU 36's function as part of the depot's mission. However, should the mission of TEAD-N change in the future, land associated with SWMU 36 may be used at some future time for residential development. Based on this assumption, the future on-site adult and child resident are evaluated for the future land use scenario.

For the future on-site adult resident, it was assumed that at least one parent would spend much of his or her time away from home in activities such as working at another location, household errands, personal care (e.g., medical/dental appointments), or leisure activities. Based on this assumption, the total estimated time an adult will spend at home is approximately 15 to 19 hours per day, during which time he or she may incidentally ingest, inhale, or come in contact

with surface soil while conducting activities such as gardening, mowing, or outdoor sports. It is also expected that the future on-site resident will grow and harvest vegetables and fruits from a home garden. For children and adolescents ages 0 to 18, time activity patterns indicate that they spend an average of approximately 30 hours per week away from home to attend school or day care. The total time a child spends at home, averaged over a 7-day week, is approximately 20 hours per day. It is assumed that residents spend 2 (RME) to 4 (CTE) weeks away from home on vacation or long holiday weekends. Therefore, the exposure frequency in real time is 335 days per year (CTE) to 350 days per year (RME). Because the contact rate for ingestion and dermal exposure is in daily units, the exposure frequency for these pathways is prorated into 24-hour-day equivalents. This ranges from 216 days per year (CTE adult) to 276 days per year (CTE child) and from 273 days per year (RME adult) to 288 days per year (RME child) (see Appendix L). Years spent at one residence for the adult/child range from 8 (CTE) to 30 (RME) years based on studies compiled by the USEPA (1989c) and AIHC (1994). Specific parameters relating to ingestion, contact, ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

Based on the continued industrial future usage of SWMU 36, it is possible that industrial construction may be conducted to increase the capacity of the military operations at TEAD-N. For these reasons, the future construction worker scenario was evaluated. It is assumed that a construction company could be contracted for a work period ranging from 1 to 3 years and a single worker could be at the site conducting activities outdoors from 2 to 4 months of the year. It is assumed that a worker works as much as 8 to 10 hours per day and may incidentally ingest, inhale, or come in contact with subsurface soil through construction-related activities. Specific parameters relating to ingestion, contact, ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

5.6.4.4.3 ***Exposure Point Concentrations.*** The EPC is defined as the concentration of a COPC in an exposure medium that will be contacted over a real or hypothetical exposure duration. EPCs at SWMU 36 were evaluated for current and future land use. Estimation of EPCs is fully described in Appendix L. For brevity, only information specific to SWMU 36 is presented in the following sections.

Current Land Use. Because the duties of on-site personnel vary, EPCs were developed for each area of concern and the SWMU as a whole to encompass all potential exposure scenarios for this receptor. EPCs in air for on-site personnel were estimated using USEPA's SCREEN2 model. Air emissions were not evaluated for each specific area of concern. It was assumed that the SWMU, as a whole, was the main source for air emission generation for all on-site receptors. Details of the estimation of emission rates from surface soils and dispersion modeling are described in Appendix N. Tables 5-197 through 5-199 list EPCs for on-site personnel associated with SWMU 36.

Future Land Use. No COPCs were retained in subsurface soils. For this reason, future land use scenarios for this media are not evaluated further for SWMU 36. Future SWMU 36 staff,

Table 5-197. Adult Exposure Point Concentrations for the Gravel Pit Hot Spot Area of Concern at SWMU 36

Chemical	Exposure Point Concentration CTE	RME
Current Land Use		
Surface Soil (mg/kg)		
Barium	580	580
Copper	1,633	1,633
Lead	1,900	1,900
Air Emissions ($\mu g/m^3$)		
Barium	0.00938	0.00938
Copper	0.00303	0.00303
Lead	0.0104	0.0104
Future Land Use[a]		
Surface Soil (mg/kg)		
Barium	580	580
Copper	1,633	1,633
Lead	1,900	1,900
Air Emissions ($\mu g/m^3$)		
Barium	0.00938	0.00938
Copper	0.00303	0.00303
Lead	0.0104	0.0104
Tubers/Fruits (mg/kg)		
Barium	1.91	1.91
Copper	89.8	89.8
Lead	3.76	3.76
Leafy Vegetables (mg/kg)		
Barium	6.09	6.09
Copper	45.7	45.7
Lead	5.99	5.99

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Table 5-198. Child Exposure Point Concentrations for the Gravel Pit Hot Spot Area of Concern at SWMU 36

	Exposure Point Concentration	
Chemical	**CTE**	**RME**
Future Land Use [(a)]		
Surface Soil (mg/kg)		
Barium	580	580
Copper	1,633	1,633
Lead	1,900	1,900
Air Emissions ($\mu g/m^3$)		
Barium	0.00938	0.00938
Copper	0.00303	0.00303
Lead	0.0104	0.0104
Tubers/Fruits (mg/kg)		
Barium	1.91	1.91
Copper	89.8	89.8
Lead	3.76	3.76
Leafy Vegetables (mg/kg)		
Barium	6.09	6.09
Copper	45.7	45.7
Lead	5.99	5.99

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Table 5-199. Adult Exposure Point Concentrations for SWMU 36 as a Whole

Chemical	Exposure Point Concentration CTE	Exposure Point Concentration RME
Current Land Use		
Surface Soil (mg/kg)		
Barium	309	309
Copper	100	100
Lead	344	344
Air Emissions ($\mu g/m^3$)		
Barium	0.00938	0.00938
Copper	0.00303	0.00303
Lead	0.0104	0.0104

such as laborers and security personnel, are covered under the current land use scenario described above.

EPCs for surface soil ingestion, dermal contact, and produce ingestion by hypothetical future on-site residents at SWMU 36 were estimated using methods described in Appendix L. EPCs for inhalation of particulates were modeled, as described in Appendix N, for the hypothetical on-site resident (see Appendix L). The EPCs are given in Tables 5-197 through 5-199.

5.6.4.4.4 ***Estimation of Chemical Intakes.*** The exposure models described in detail in Appendix L together with EPCs listed in Tables 5-197, 5-198, and 5-199 were used to estimate intake for the potential exposure scenarios. Note that averaging time differs for carcinogens and noncarcinogens. Estimates of exposure intakes are given in Tables 5-200 through 5-203.

5.6.4.5 *Toxicity Assessment*

Information of the toxicological effects of carcinogenic and systemic toxicants are summarized in Appendix M. This toxicity assessment includes brief toxicity profiles on data listed in USEPA's IRIS database and published in HEAST (USEPA 1994c). These profiles describe the acute, chronic, and carcinogenic health effects associated with SWMU-related chemicals. Toxicity values for COPCs associated with areas of concern for SWMU 36 are summarized in Tables 5-200 through 5-203.

5.6.4.6 *Risk Characterization*

This section provides a characterization of the potential health risks associated with the intake of chemicals associated with the Gravel Pit Hot Spot area of concern and SWMU 36 as a whole. The risk characterization compares estimated potential ILCRs with reasonable levels of risk for potential carcinogens (see Section 3.1.4.1), and the estimated daily intake of systemic toxicants with appropriate reference levels. Some carcinogenic chemicals may also pose a systemic hazard, and these potential hazards are characterized as for other systemic toxicants.

5.6.4.6.1 ***Characterization of Potential Carcinogenic Risks.*** The USEPA currently classified lead salts as probable human carcinogens (Class B2). However, quantifying lead's cancer risk involves many uncertainties, some of which may be unique to lead. Age, health, nutritional state, body burden, and exposure duration influence the absorption, release, and excretion of lead. In addition, current knowledge of lead pharmacokinetics indicates that an estimate derived by standard procedures would not truly describe the potential risk. Thus, the USEPA's Carcinogen Assessment Group recommends that a numerical estimate not be used (USEPA 1995a).

Table 5-200. Summary of Potential Systemic Effects for the Current/Future On-site Laborer for SWMU 36 (Gravel Pit Hot Spot)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Barium	5.80E+02	1.4E-06	7.0E-02	2.0E-05	
Copper	1.63E+03	3.9E-06	3.7E-02	1.1E-04	
Lead	1.90E+03	NA(d)	NA	NA	
			Pathway Total:	1.2E-04	91%
Dermal Contact with Surface Soil					
Barium	5.80E+02	6.9E-08	7.0E-03	9.9E-06	
Copper	1.63E+03	NA	NA	NA	
Lead	1.90E+03	NA	NA	NA	
			Pathway Total:	9.9E-06	7%
Inhalation of Particulates					
Barium	9.38E-06	4.3E-10	1.4E-04	3.0E-06	
Copper	3.03E-06	NA	NA	NA	
Lead	1.04E-05	NA	NA	NA	
			Pathway Total:	3.0E-06	2%
			Total CTE HI:	1.4E-04	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Barium	5.80E+02	1.3E-04	7.0E-02	1.9E-03	
Copper	1.63E+03	3.7E-04	3.7E-02	1.0E-02	
Lead	1.90E+03	NA	NA	NA	
			Pathway Total:	1.2E-02	73%
Dermal Contact with Surface Soil					
Barium	5.80E+02	1.5E-05	7.0E-03	2.2E-03	
Copper	1.63E+03	NA	NA	NA	
Lead	1.90E+03	NA	NA	NA	
			Pathway Total:	2.2E-03	13%
Inhalation of Particulates					
Barium	9.38E-06	3.1E-07	1.4E-04	2.2E-03	
Copper	3.03E-06	NA	NA	NA	
Lead	1.04E-05	NA	NA	NA	
			Pathway Total:	2.2E-03	13%
			Total RME HI:	1.6E-02	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-201. Summary of Potential Systemic Effects for the Future On-site Adult Resident for SWMU 36 (Gravel Pit Hot Spot)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Barium	5.80E+02	4.8E-05	7.0E-02	6.8E-04	
Copper	1.63E+03	1.3E-04	3.7E-02	3.6E-03	
Lead	1.90E+03	NA(d)	NA	NA	
			Pathway Total:	4.3E-03	0%
Dermal Contact with Surface Soil					
Barium	5.80E+02	2.4E-06	7.0E-03	3.4E-04	
Copper	1.63E+03	NA	NA	NA	
Lead	1.90E+03	NA	NA	NA	
			Pathway Total:	3.4E-04	0%
Inhalation of Particulates					
Barium	9.38E-06	3.2E-07	1.4E-04	2.2E-03	
Copper	3.03E-06	NA	NA	NA	
Lead	1.04E-05	NA	NA	NA	
			Pathway Total:	2.2E-03	0%
Ingestion of Leafy Vegetables					
Barium	6.09E+00	8.5E-04	7.0E-02	1.2E-02	
Copper	4.57E+01	6.4E-03	3.7E-02	1.7E-01	
Lead	5.99E+00	NA	NA	NA	
			Pathway Total:	1.9E-01	14%
Ingestion of Tubers and Fruits					
Barium	1.91E+00	9.0E-04	7.0E-02	1.3E-02	
Copper	8.98E+01	4.2E-02	3.7E-02	1.1E+00	
Lead	3.76E+00	NA	NA	NA	
			Pathway Total:	1.2E+00	86%
			Total CTE HI:	1.3E+00	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Barium	5.80E+02	3.0E-04	7.0E-02	4.3E-03	
Copper	1.63E+03	8.5E-04	3.7E-02	2.3E-02	
Lead	1.90E+03	NA	NA	NA	
			Pathway Total:	2.7E-02	1%
Dermal Contact with Surface Soil					
Barium	5.80E+02	3.5E-05	7.0E-03	5.0E-03	
Copper	1.63E+03	NA	NA	NA	
Lead	1.90E+03	NA	NA	NA	
			Pathway Total:	5.0E-03	0%
Inhalation of Particulates					
Barium	9.38E-06	4.5E-07	1.4E-04	3.2E-03	
Copper	3.03E-06	NA	NA	NA	
Lead	1.04E-05	NA	NA	NA	
			Pathway Total:	3.2E-03	0%
Ingestion of Leafy Vegetables					
Barium	6.09E+00	3.0E-03	7.0E-02	4.3E-02	
Copper	4.57E+01	2.2E-02	3.7E-02	6.1E-01	
Lead	5.99E+00	NA	NA	NA	
			Pathway Total:	6.5E-01	14%
Ingestion of Tubers and Fruits					
Barium	1.91E+00	3.2E-03	7.0E-02	4.5E-02	
Copper	8.98E+01	1.5E-01	3.7E-02	4.0E+00	
Lead	3.76E+00	NA	NA	NA	
			Pathway Total:	4.1E+00	86%
			Total RME HI:	4.7E+00	100%

[a]Units for the inhalation pathway are mg/m3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-202. Summary of Potential Systemic Effects for the Future On-site Child Resident for SWMU 36 (Gravel Pit Hot Spot)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Barium	5.80E+02	2.2E-04	7.0E-02	3.1E-03	
Copper	1.63E+03	6.1E-04	3.7E-02	1.6E-02	
Lead	1.90E+03	NA(d)	NA	NA	
			Pathway Total:	2.0E-02	1%
Dermal Contact with Surface Soil					
Barium	5.80E+02	4.0E-06	7.0E-03	5.7E-04	
Copper	1.63E+03	NA	NA	NA	
Lead	1.90E+03	NA	NA	NA	
			Pathway Total:	5.7E-04	0%
Inhalation of Particulates					
Barium	9.38E-06	1.6E-06	1.4E-04	1.1E-02	
Copper	3.03E-06	NA	NA	NA	
Lead	1.04E-05	NA	NA	NA	
			Pathway Total:	1.1E-02	1%
Ingestion of Leafy Vegetables					
Barium	6.09E+00	1.4E-03	7.0E-02	2.0E-02	
Copper	4.57E+01	1.0E-02	3.7E-02	2.8E-01	
Lead	5.99E+00	NA	NA	NA	
			Pathway Total:	3.0E-01	14%
Ingestion of Tubers and Fruits					
Barium	1.91E+00	1.5E-03	7.0E-02	2.1E-02	
Copper	8.98E+01	6.9E-02	3.7E-02	1.9E+00	
Lead	3.76E+00	NA	NA	NA	
			Pathway Total:	1.9E+00	85%
			Total CTE HI:	2.2E+00	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Barium	5.80E+02	1.1E-03	7.0E-02	1.5E-02	
Copper	1.63E+03	3.0E-03	3.7E-02	8.2E-02	
Lead	1.90E+03	NA	NA	NA	
			Pathway Total:	9.7E-02	2%
Dermal Contact with Surface Soil					
Barium	5.80E+02	2.4E-05	7.0E-03	3.5E-03	
Copper	1.63E+03	NA	NA	NA	
Lead	1.90E+03	NA	NA	NA	
			Pathway Total:	3.5E-03	0%
Inhalation of Particulates					
Barium	9.38E-06	1.2E-06	1.4E-04	8.3E-03	
Copper	3.03E-06	NA	NA	NA	
Lead	1.04E-05	NA	NA	NA	
			Pathway Total:	8.3E-03	0%
Ingestion of Leafy Vegetables					
Barium	6.09E+00	3.3E-03	7.0E-02	4.7E-02	
Copper	4.57E+01	2.5E-02	3.7E-02	6.6E-01	
Lead	5.99E+00	NA	NA	NA	
			Pathway Total:	7.1E-01	14%
Ingestion of Tubers and Fruits					
Barium	1.91E+00	3.4E-03	7.0E-02	4.9E-02	
Copper	8.98E+01	1.6E-01	3.7E-02	4.4E+00	
Lead	3.76E+00	NA	NA	NA	
			Pathway Total:	4.4E+00	84%
			Total RME HI:	5.2E+00	100%

[a]Units for the inhalation pathway are mg/m3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 5-203. Summary of Potential Systemic Effects for the Current/Future On-site Laborer for SWMU 36 as a Whole

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Barium	3.09E+02	7.4E-07	7.0E-02	1.1E-05	
Copper	1.00E+02	2.4E-07	3.7E-02	6.4E-06	
Lead	3.44E+02	NA[d]	NA	NA	
			Pathway Total:	1.7E-05	67%
Dermal Contact with Surface Soil					
Barium	3.09E+02	3.7E-08	7.0E-03	5.3E-06	
Copper	1.00E+02	NA	NA	NA	
Lead	3.44E+02	NA	NA	NA	
			Pathway Total:	5.3E-06	21%
Inhalation of Particulates					
Barium	9.38E-06	4.3E-10	1.4E-04	3.0E-06	
Copper	3.03E-06	NA	NA	NA	
Lead	1.04E-05	NA	NA	NA	
			Pathway Total:	3.0E-06	12%
			Total CTE HI:	2.5E-05	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Barium	3.09E+02	7.0E-05	7.0E-02	1.0E-03	
Copper	1.00E+02	2.3E-05	3.7E-02	6.2E-04	
Lead	3.44E+02	NA	NA	NA	
			Pathway Total:	1.6E-03	33%
Dermal Contact with Surface Soil					
Barium	3.09E+02	8.2E-06	7.0E-03	1.2E-03	
Copper	1.00E+02	NA	NA	NA	
Lead	3.44E+02	NA	NA	NA	
			Pathway Total:	1.2E-03	24%
Inhalation of Particulates					
Barium	9.38E-06	3.1E-07	1.4E-04	2.2E-03	
Copper	3.03E-06	NA	NA	NA	
Lead	1.04E-05	NA	NA	NA	
			Pathway Total:	2.2E-03	44%
			Total RME HI:	5.0E-03	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Gravel Pit Hot Spot Area of Concern. The general process used to select the COPCs associated with the Gravel Pit Hot Spot area of concern associated with SWMU 36 is described in Section 3.1.1. COPC selection for SWMU 36 is described in Section 5.6.4.2. For current and future land use scenarios, barium, copper, and lead were identified as COPCs. None of the COPCs identified are known or suspected carcinogens; therefore, carcinogenic risk estimates were not quantitatively evaluated. Tables 5-197 and 5-198 list the COPCs and their associated media.

SWMU 36 as a Whole. The general process used to select the COPCs associated with SWMU 36 as a whole is described in Section 3.1.1. COPC selection for SWMU 36 is described in Section 5.6.4.2. For current and future land use scenarios, barium, copper, and lead were identified as COPCs. None of the COPCs identified are known or suspected carcinogens; therefore, carcinogenic risk estimates were not quantitatively evaluated. Table 5-199 lists the COPCs and their associated media.

Current/Future On-site Laborer. The cumulative ILCR for all pathways was not estimated because the COPCs associated with SWMU 36 are not classified as carcinogens.

5.6.4.6.2 *Characterization of Potential Systemic Effects*

Gravel Pit Hot Spot Area of Concern. The general process used to select the COPCs associated with the Gravel Pit Hot Spot area of concern is described in Section 3.1.1. COPC selection for SWMU 36 is described in Section 5.6.4.2. For current and future land use scenarios, barium, copper, and lead were identified as COPCs. With the exception of lead, all COPCs were evaluated for potential systemic effects. Tables 5-197 and 5-198 list the COPCs and their associated media.

Current/Future Laborer. As summarized in Table 5-200, the summed HI for all pathways is does not exceed unity (one). The summed HIs range from 1.6E-02 to 1.4E-04 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of surface soil, which contributes greater than 73 percent of the total HI. The major contributor to the risk estimate is copper.

Future On-site Adult Resident. As summarized in Table 5-201, the summed HI for all pathways is 4.7E+00 and 1.3E+00 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of produce, which contributes nearly 100 percent of the total HI.

Ingestion of produce by adults results in an estimated HI of 4.7E+00 and 1.3E+00 using RME and CTE parameters, respectively. For the remaining pathways evaluated—ingestion of surface soil, dermal contact with surface soil, and inhalation of particulates—the summed HIs do not exceed unity (one). The summed HIs for these pathways range from 2.7E-02 to 3.4E-04 for the RME and CTE scenarios, respectively. The main contributor to the estimated HI is copper.

Future On-site Child Resident. As summarized in Table 5-202, the summed HI for all pathways is 5.2E+00 and 2.2E+00 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of produce, which contributes nearly 100 percent of the total HI.

Ingestion of produce results in an estimated HI of 5.1E+00 and 2.2E+00 using RME and CTE parameters, respectively. For the remaining pathways evaluated—ingestion of surface soil, dermal contact with surface soil, and inhalation of particulates—the summed HIs do not exceed unity (one). The summed HIs for these pathways range from 9.7E-02 to 5.7E-04 for the RME and CTE scenarios, respectively. The main contributor to the estimated HI is copper.

SWMU 36 as a Whole. The general process used to select the COPCs associated with SWMU 36 as a whole is described in Section 3.1.1. COPC selection for SWMU 36 is described in Section 5.6.4.2. For current and future land use scenarios, barium, copper, and lead were identified as COPCs. With the exception of lead, all COPCs were evaluated for potential systemic effects. Table 5-199 lists the COPC and their associated media.

Current/Future Laborer. As summarized in Table 5-203, the summed HI for all pathways does not exceed unity (one). The summed HIs range from 5.0E-03 to 2.5E-05 for the RME and CTE scenarios, respectively. The major contributor to the risk estimate is barium.

5.6.4.6.3 *Characterization of Hazards Associated with Exposures to Lead*

Current Off-site Child Residents. The USEPA has developed the IEUBK model to evaluate lead exposure in children. The model estimates blood lead levels resulting from all applicable routes of exposure. The agency has set a target blood lead level of 10 μg Pb/dL blood. The IEUBK model was run for potential off-site residential exposures to resuspended lead-containing particulate. All defaults in the model were maintained except the input air concentration. This input value was the boundary line concentration resulting from the air dispersion modeling (Appendix N). Predicted mean blood lead levels ranged from 4.5 μg Pb/dL blood for children aged 1 to 2 years down to 2.7 μg Pb/dL blood for children aged 6 to 7 years. Mean blood lead level for the age span 0 to 7 years was 3.7 μg Pb/dL blood, which is below the USEPA target blood lead level of 10 μg Pb/dL blood.

Future On-site Child Residents. The IEUBK model was run for potential future on-site residential exposures to lead in soil, produce, air, and drinking water. All defaults in the model were maintained except the input air, soil, and produce concentrations and the parameters—time spent outdoors, 3 hours/day, and lung absorption rate, 50 percent (see Appendix L). The input air value is the boundary line concentration resulting from the air dispersion modeling (Appendix N). Lead concentrations in soil and produce are based on an average EPC for lead. Predicted mean blood lead levels ranged from 6.1 μg Pb/dL blood for children aged 1 to 2 years down to 3.6 μg Pb/dL blood for children aged 6 to 7 years. Mean blood lead level for the age span 0 to 7 years is 5.01 μg Pb/dL blood, which is below the

USEPA target blood lead level of 10 μg Pb/dL blood. Soil and dust uptake is the driving pathway, contributing greater than 50 percent of the total blood lead level.

Occupational Exposure. The agency recognizes that this approach is not appropriate for land use best described by non-residential adult exposure (USEPA 1994d). The agency has recommended a short-term option based on a simple approach that approximates the more complicated biokinetics in humans. Models for adult exposure are available in the scientific literature that meet USEPA's short-term criterion. Exposures and acceptable residual soil levels were estimated using the model developed by Bowers and colleagues (1994) as modified by USEPA Region VIII in the risk assessment for the California Gulch Superfund site (USEPA 1995b) (see Appendix O). A target blood lead level range of 11.1 μg Pb/dL blood was used in the evaluation to account for women of child-bearing age in the work force (USEPA 1995b).

For the on-site laborer, two exposure settings were used to estimate the blood lead levels for the CTE and RME exposure scenarios—Gravel Pit Hot Spot area of concern and SWMU 36 as a whole. For both the RME (2.25 to 2.39) and CTE (2.20) scenarios, the target blood levels (2.39) are below the target blood lead level of 11.1 μg Pb/dL blood.

5.6.4.7 *Risk Assessment Summary and Conclusions*

An RA was conducted for the Old Burn Staging Area based on Phase I and Phase II RI data. Due to a lack of subsurface COPCs, only three scenarios—on-site laborer/security worker, on-site adult resident, and on-site child resident—were quantitatively evaluated. For these scenarios, an RME and central tendency (or "most-likely-to-occur") exposure (CTE) was evaluated. Incremental lifetime cancer risks were not estimated because COPCs associated with SWMU 36 are not classified as carcinogens. Tables 5-204 and 5-205 summarize total ILCRs and HIs for the RME and CTE future and current land-use scenarios for SWMU 36. For the potential future on-site resident, the summed HI ranges from 4.7 to 1.3 for the adult and 5.2 to 2.2 for the child based on RME and CTE exposure scenarios. The driving pathway is ingestion of produce with the main contributor being copper.

Food-chain pathways (i.e., home gardening) are significant contributors to total risks. According to Lee Sherry, a home economist with the Utah State University Agricultural Extension Service in Tooele, saline content in area soils generally require home gardeners and landscapers to replace or augment the existing soil with new topsoil. The above observation is confirmed by soil testing results from the Utah State University Soil Testing Laboratory (Appendix G).

Due to a lack of verified toxicity data for lead, potential systemic effects for that metal were quantitatively evaluated based on USEPA's Integrated Exposure Uptake Biokinetic Model (USEPA 1994) for lead in children. The model estimates blood lead levels resulting from all applicable routes of exposure. The agency has set a target blood lead level of 10 μg Pb/dL blood. For the inhalation of particulates pathway for the current off-site child resident, a mean

Table 5-204. Summary of CTE Risk Results for SWMU 36

	Gravel Pit Hot Spot			SWMU as a Whole		
Scenario	HI	ILCR	Blood Lead Levels (μg Pb/dL Blood)	HI	ILCR	Blood Lead Levels (μg Pb/dL Blood)
Current Land Use						
On-site Laborer	1.4E-04	---	2.20	2.5E-05	---	2.20
Off-site Child Resident	---	---	---	---	---	3.70
Future Land Use						
On-site Adult Resident	1.3E+00	---	---[a]	---	---	---
On-site Child Resident	2.2E+00	---	5.00	---	---	---

[a]Per EPA Guidance, the IEUBK model is designed for the child receptor, who is the most sensitive receptor. Therefore, blood lead levels for the adult receptor were not quantified.

Table 5-205. Summary of RME Risk Results for SWMU 36

	Gravel Pit Hot Spot			SWMU as a Whole		
Scenario	HI	ILCR	Blood Lead Levels (μg Pb/dL Blood)	HI	ILCR	Blood Lead Levels (μg Pb/dL Blood)
Current Land Use						
On-site Laborer	1.6E-02	---	2.39	5.0E-03	---	2.25
Off-site Child Resident	---	---	---	---	---	3.70
Future Land Use						
On-site Adult Resident	4.7E+00	---	---[a]	---	---	---
On-site Child Resident	5.2E+00	---	5.00	---	---	---

[a]Per EPA Guidance, the IEUBK model is designed for the child receptor, who is the most sensitive receptor. Therefore, blood lead levels for the adult receptor were not quantified.

blood lead level of 3.7 μg Pb/dL for the age span 0 to 7 years was estimated, which is below the USEPA target blood lead level of 10 μg Pb/dL blood. Predicted mean blood lead levels for the hypothetical on-site child resident ranged from 6.1 μg Pb/dL blood for children aged 1 to 2 years down to 3.6 μg Pb/dL blood for children aged 6 to 7 years. Mean blood lead level for the age span 0 to 7 years is 5.01 μg Pb/dL blood, which is below the USEPA target blood lead level of 10 μg Pb/dL blood.

For the on-site laborer, two exposure settings were used to estimate the blood lead levels for the CTE and RME exposure scenarios—Gravel Pit Hot Spot area of concern and SWMU 36 as a whole. For both the RME and CTE scenarios, the blood lead levels for the on-site laborer are below the target blood lead level of 11.1 μg Pb/dL blood, which was used to evaluate women of child-bearing age in the work force (USEPA 1995b). Given that there is currently no full-time work force at SWMU 8, no remediation appears warranted based on human exposure to lead.

It should be remembered that any estimate of risk is dependent on the concurrent validity of all assumptions used to construct the exposure model. In other words, the estimates rely on several activities recurring with constant intensity and in predictable order. For example, produce ingestion assumes a constant consumption rate every day for durations up to 30 years for adults and 18 years for children.

Due to the lack of COPCs known or suspected to be carcinogens at SWMU 36, the following summarizes only the total RME HIs estimated for current and future land use scenarios at SWMU 36:

- Current/future on-site laborer—1.6E-02 (Hot Spot HI) and 5.0E-03 (SWMU HI)
- Future on-site adult resident—4.7E+00 (Hot Spot HI)
- Future on-site child resident—5.2E+00 (Hot Spot HI)

When site-specific conditions are considered along with the conservative assumptions designed to offset assessment uncertainties, the risk estimates for the future residential scenario are, in point of fact, likely to be overestimates at a minimum. Under the current BRAC, SWMU 36 is not included in the parcel for potential release for private redevelopment. In fact, the mission of SWMU 36 is assumed to continue into the indefinite future. Based on the available analytical data and the above considerations, the risk assessment results indicate that there is no immediate and substantial danger to human health from the presence of low levels of hazardous chemicals at SWMU 36.

5.6.5 Conclusions and Recommendations

Metals were the only analytes sampled for during the Phase II RI field investigation at the Old Burn Staging Area (SWMU 36). Sample results indicate metals were detected exceeding background concentrations in surface soils. Mercury was the only metal exceeding its

background concentration in subsurface soils. Metals were found primarily in areas where surface burning had taken place and metal debris is still present.

A baseline human health risk assessment was conducted at SWMU 36 to determine any potential human health risks associated with a no-action alternative. Evaluation of the Phase I and Phase II RI data according to USEPA guidance and procedures resulted in identification of three metals—barium, copper, and lead—as COPCs at SWMU 36.

Ecological risk results for SWMU 36 are presented in the SWERA (Rust E&I 1996).

Based on the results of the risk assessment, no adverse effect to human health under current land use scenarios should arise. Therefore, it is recommended that no further remedial investigations need be conducted. Future on-site residents would be at risk from ingestion of produce from the hot spot portion of SWMU 36. A feasibility study will be conducted for SWMU 36, as required by CERCLA, to determine if any remedies are required for this SWMU. Hot spot cleanup may effectively reduce risks to potential future scenario receptors to acceptable levels. Conclusions from this report and the SWERA will be used during the FS process to derive final recommendations for SWMU 36.

5.7 GRAZING ALLOTMENT 1

Because areas of the depot are used for grazing purposes (see Section 3.1), the potential risks associated with consumption of beef from cattle grazed at TEAD-N were evaluated separately. TEAD-N is divided into eight grazing units (Figure 5-23). Grazing Allotment 1 is comprised of SWMU 6, 7, 13, 22, 23, and 36 (OU 8); Grazing Allotment 2 has only SWMU 40; and Grazing Allotment 3 contains SWMU 8. Specific records are not available to identify individual cattle grazing on each allotment, and cattle are allowed to wander freely about within each allotment. Potential contribution to the human health risk from consumption of cattle grazed on Grazing Allotment 1 is considered on the basis of the total allotment, rather than by individual SWMUs.

5.7.1 Human Health Risk Assessment

As part of the Phase II RI, an RA was conducted to estimate potential human health risks associated with the no-action alternative for Grazing Allotment 1. The following tasks were completed in the RA:

- Data analysis and selection of COPCs
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Summary and conclusions

This section provides a summary of the quantitative process employed at Grazing Allotment 1 and the results of that process. The RA for Grazing Allotment 1 is based on the methodology described in Section 3.1 and supported by Appendices L and M.

5.7.1.1 *Identification of Chemicals of Potential Concern*

Section 3.1.1 discusses the steps taken to validate field data and determine usability in quantitative risk assessment based on USEPA guidance (USEPA 1992b). The resulting data base for SWMUs 6, 7, 13, 22, 23, and 36 provided COPCs for Grazing Allotment 1. For a SWMU-specific discussion of identification of COPCs see the previous sections.

5.7.1.2 *Exposure Assessment*

Cattle grazing is permitted at TEAD-N, with grazing allotments competitively bid and leased every 5 years to a single rancher. The current lease is up for rebid in 1996. Grazing at TEAD-N typically occurs between October 15 and May 31, with calving taking place in January. The calves remain at the facility until May 31 when they are either moved to feedlots or to other grazing areas. The calves typically do not return to TEAD-N after their initial exposure, and they are eventually sold as slaughter cattle for human consumption.

Distribution is through regional and national distribution networks. The cows are normally utilized as breeding stock and may or may not return to the site during consecutive years. The current lessee brings approximately 1,000 head, mostly heifers, to winter pasture at TEAD-N and maintains summer pasture in Idaho (M. Walker, personal communication with Rust E&I, 1994).

To evaluate potential health risks associated with the consumption of beef cattle grazed on TEAD-N, as well as produce that in the future may be grown on site, it was necessary to model COPC concentrations in plants grown in soils potentially affected by site conditions. Plant uptake will vary with plant species and on a chemical-by-chemical basis. Because efforts to conduct bioassays were unsuccessful at TEAD-N (see Section 2.2.11), plant concentrations were estimated using published plant-chemical uptake factors (Baes et al.1984; USEPA 1989b; Stevens 1992). Where uptake factors were not available, estimates were made using published methodologies employing the octanol-water partition coefficient (K_{ow}) (Travis and Arms 1988; McKone 1994). Once forage crop concentrations were estimated, transfer to beef muscle tissue was modeled. This estimate was the EPC for the human exposure model. The current beef consumer is assumed to eat approximately 1 to 3 ounces of beef a day, of which 44 to 88 percent originates from the Grazing Allotment 1.

The exposure models described in detail in Appendix L and the EPCs listed in Table 5-206 were used to estimate intake for the potential exposure scenarios. Note that averaging time differs for carcinogens and noncarcinogens. As in other risk assessment scenarios, exposures for young children and adolescents ages 0 to 18 years were estimated separately from the adults. Estimates of exposure intakes are given in Table 5-206.

5.7.1.3 *Toxicity Assessment*

Information of the toxicological effects of carcinogenic and systemic toxicants are summarized in Appendix M. This toxicity assessment includes brief toxicity profiles on data listed in USEPA's IRIS database and published in HEAST (USEPA 1994c). These profiles describe the acute, chronic, and carcinogenic health effects associated with SWMU-related chemicals. Toxicity values for COPCs associated with Grazing Allotment 1 are summarized in Table 5-206.

5.7.1.4 *Risk Characterization*

This section provides a characterization of the potential health risks associated with the intake of chemicals associated with Grazing Allotment 1. The risk characterization compares estimated potential ILCRs with reasonable levels of risk for potential carcinogens (see Section 3.1.4.1) and the estimated daily intake of systemic toxicants with appropriate reference levels. Some carcinogenic chemicals may also pose a systemic hazard, and these potential hazards are characterized as for other systemic toxicants.

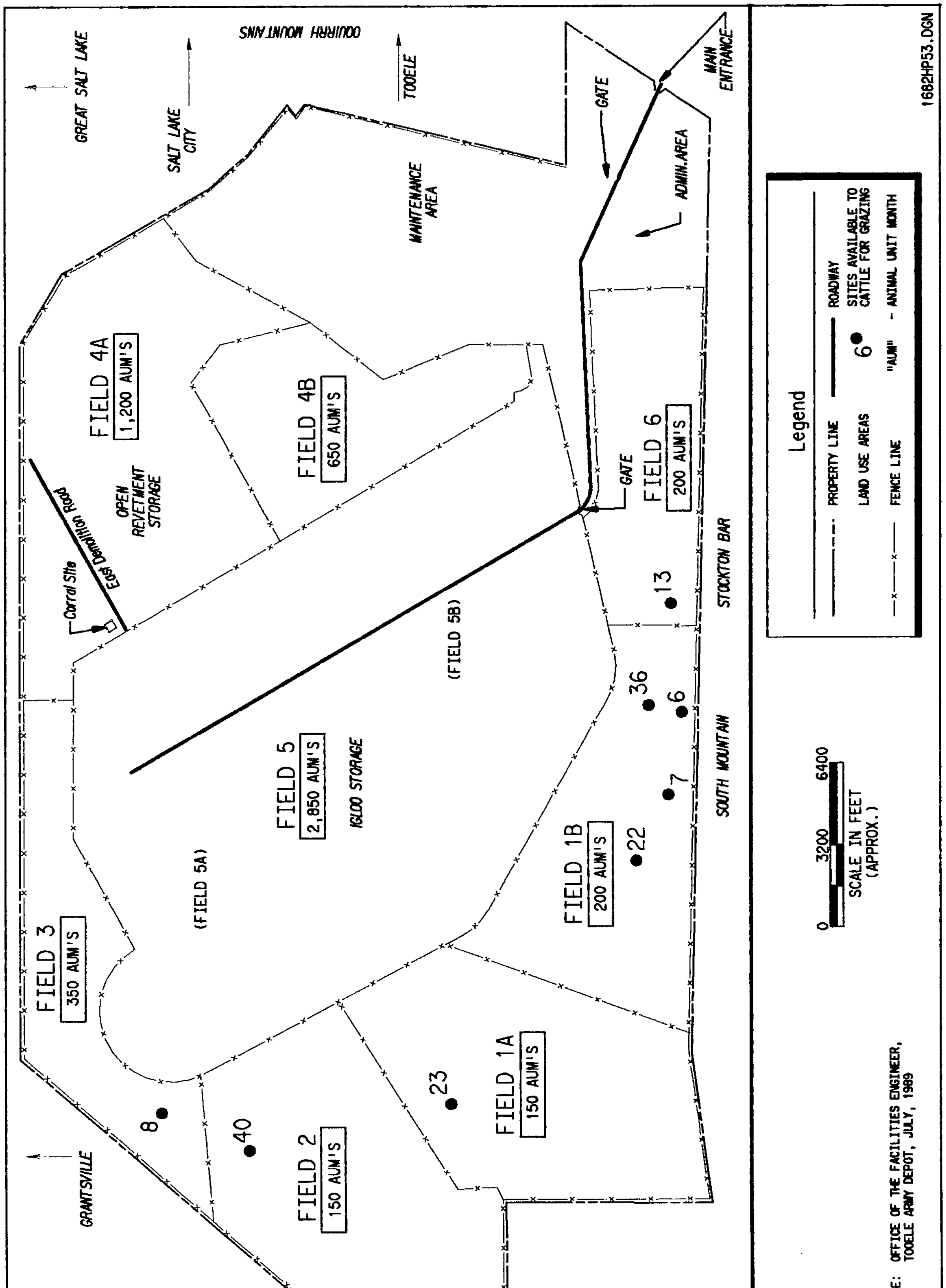

Figure 5-23. Grazing Units at TEAD-N

Table 5-206. Adult and Child Exposure Point Concentrations for Beef Tissue from Cattle Associated with Grazing Allotment 1

	Exposure Point Concentration	
Chemical	**CTE**	**RME**
Current Land Use		
Beef Tissue - Adult (mg/kg)		
Aluminum	0.89	0.89
Anthracene	0.000000011	0.000000046
Arsenic	0.000064	0.000064
Barium	0.000014	0.000014
Beryllium	0.000029	0.000029
Cadmium	0.00000041	0.00000041
Chloromethane	0.000000000011	0.000000000012
Chromium	0.000042	0.000042
Copper	0.0053	0.0053
Lead	0.000043	0.000043
Manganese	0.014	0.014
c-PAHs[(a)]	0.00000052	0.0000043
PCBs (total)	0.0000022	0.0000022
Phenanthrene	0.000000022	0.00000013
Pyrene	0.0000011	0.0000066
RDX	0.000000019	0.000000019
Thallium	0.036	0.036
1,3,5-Trinitrobenzene	0.0000013	0.0000013
2,4,6-Trinitrotoluene	0.0000032	0.0000032
Beef Tissue - Child (mg/kg)		
Aluminum	0.89	0.89
Anthracene	0.000000019	0.000000077
Arsenic	0.000064	0.000064
Barium	0.000014	0.000014
Beryllium	0.000029	0.000029
Cadmium	0.00000041	0.00000041
Chloromethane	0.000000000011	0.000000000019
Chromium	0.000042	0.000042
Copper	0.0053	0.0053
Lead	0.000043	0.000043
Manganese	0.014	0.014
c-PAHs[(a)]	0.0000017	0.0000071
PCBs (total)	0.0000022	0.0000022
Phenanthrene	0.000000038	0.00000021
Pyrene	0.0000028	0.000010
RDX	0.000000019	0.000000019
Thallium	0.036	0.036
1,3,5-Trinitrobenzene	0.0000000013	0.0000000013
2,4,6-Trinitrotoluene	0.0000032	0.0000032

[a]Benzo(a)pyrene-equivalent of total carcinogenic PAH concentration.

5.7.1.4.1 *Characterization of Potential Carcinogenic Risks.* The USEPA currently classifies lead salts as probable human carcinogens (Class B2). However, quantifying lead's cancer risk involves many uncertainties, some of which may be unique to lead. Age, health, nutritional state, body burden, and exposure duration all influence the absorption, release, and excretion of lead. In addition, current knowledge of lead pharmacogenetics indicates that an estimate derived by standard procedures would not truly describe the potential risk. Thus, the USEPA's Carcinogen Assessment Group recommends that a numerical estimate not be used (USEPA 1995a).

Current Adult Beef Consumer. The ILCR for ingestion of beef associated with Grazing Allotment 1 by the adult residents in the surrounding communities is 1.1E-07 and 6.3 E-09 under the RME and CTE scenarios, respectively, and is summarized in Table 5-207. The driving COPC is beryllium, which contributes greater than 50 percent of the total ILCR.

Current Child Beef Consumer. The ILCR for ingestion of beef associated with Grazing Allotment 1 by the child residents in the surrounding communities is 1.1E-07 and 1.5E-08 under the RME and CTE scenarios, respectively, and is summarized in Table 5-208. The driving COPC is beryllium, which contributes greater than 50 percent of the total ILCR.

5.7.1.4.2 *Characterization of Potential Systemic Effects.* Thallium's systemic effects relate primarily to the organs (i.e., liver and kidney) as target endpoints (Casarett and Doull 1991). Statistics indicated that beef organ meat comprises less than 0.5 per cent of the total adult dietary meat intake for populations in the western region of the United States (USDA 1993). It should also be noted that the reference dose used to estimated systemic effects from exposure to thallium in beef tissue is for thallium sulfate, a thallium salt. As a conservative estimate, it was assumed that all thallium detected was thallium sulfate. Based on the above information, the estimated systemic effects of thallium in beef tissue are very conservative.

Current Adult Beef Consumer. As summarized in Table 5-209, the summed HI for the ingestion of beef pathway is 4.5E-01 and 1.1E-01 for the RME and CTE scenarios, respectively. The driving COPC is thallium, which contributes greater than 99 percent of the summed HI.

Current Child Beef Consumer. As summarized in Table 5-210, the summed HI for the ingestion of beef pathway is 6.9E-01 and 2.4E-01 for the RME and CTE scenarios, respectively. The driving COPC is thallium, which contributes greater than 99 percent of the summed HI.

5.7.1.4.3 *Characterization of Hazards Associated with Exposures to Lead.* Uptake of lead into beef muscle tissue was modeled using the transfer factor from feed to muscle proposed by Stevens (1992). This is almost certainly an overestimate because lead is considered to bioconcentrate in offal and bone. Nonetheless, the modeled concentration in muscle is at least three to four orders of magnitude below the value of 0.02 μg/g cited by USEPA (1986c) as a

Table 5-207. Summary of Potential Carcinogenic Risk Results for the Current Adult Beef Consumer of Cattle from Grazing Allotment 1

Chemical	Exposure Point Concentration (mg/kg)[(a)]	Daily Carcinogenic Intake[(b)] (mg/kg-day)	Carcinogenic Slope Factor[(c)] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Beef					
Aluminum	8.9E-01	NA[(d)]	NA	NA	
Anthracene	1.1E-08	NA	NA	NA	
Arsenic	6.4E-05	1.7E-09	1.5E+00	2.5E-09	
Barium	1.4E-05	NA	NA	NA	
Beryllium	2.9E-05	7.7E-10	4.3E+00	3.3E-09	
Cadmium	4.1E-07	NA	NA	NA	
Chloromethane	1.1E-11	2.8E-16	1.3E-02	3.6E-18	
Chromium	4.2E-05	NA	NA	NA	
Copper	5.3E-03	NA	NA	NA	
Lead	4.3E-05	NA	NA	NA	
Manganese	1.4E-02	NA	NA	NA	
c-PAHs, total[(e)]	5.2E-07	1.4E-11	7.3E+00	9.9E-11	
PCBs, total[(f)]	2.2E-06	5.7E-11	7.7E+00	4.4E-10	
Phenanthrene	2.2E-08	NA	NA	NA	
Pyrene	1.1E-06	NA	NA	NA	
RDX	1.9E-08	4.8E-13	1.1E-01	5.3E-14	
Thallium	3.6E-02	NA	NA	NA	
1,3,5-Trinitrobenzene	1.3E-09	NA	NA	NA	
2,4,6-Trinitrotoluene	3.2E-06	8.5E-11	3.0E-02	2.5E-12	
			Total CTE ILCR:	6.3E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Beef					
Aluminum	8.9E-01	NA	NA	NA	
Anthracene	4.6E-08	NA	NA	NA	
Arsenic	6.4E-05	2.6E-08	1.5E+00	3.8E-08	
Barium	1.4E-05	NA	NA	NA	
Beryllium	2.9E-05	1.2E-08	4.3E+00	5.1E-08	
Cadmium	4.1E-07	NA	NA	NA	
Chloromethane	1.2E-11	4.6E-15	1.3E-02	6.0E-17	
Chromium	4.2E-05	NA	NA	NA	
Copper	5.3E-03	NA	NA	NA	
Lead	4.3E-05	NA	NA	NA	
Manganese	1.4E-02	NA	NA	NA	
c-PAHs, total	4.3E-06	1.7E-09	7.3E+00	1.2E-08	
PCBs, total	2.2E-06	8.8E-10	7.7E+00	6.8E-09	
Phenanthrene	1.3E-07	NA	NA	NA	
Pyrene	6.6E-06	NA	NA	NA	
RDX	1.9E-08	7.4E-12	1.1E-01	8.2E-13	
Thallium	3.6E-02	NA	NA	NA	
1,3,5-Trinitrobenzene	1.3E-09	NA	NA	NA	
2,4,6-Trinitrotoluene	3.2E-06	1.3E-09	3.0E-02	3.9E-11	
			Total RME ILCR:	1.1E-07	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

[e]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.

[f]PCB 1248 and PCB 1254.

Table 5-208. Summary of Potential Carcinogenic Risk Results for the Current Child Beef Consumer of Cattle from Grazing Allotment 1

Chemical	Exposure Point Concentration (mg/kg)[(a)]	Daily Carcinogenic Intake[(b)] (mg/kg-day)	Carcinogenic Slope Factor[(c)] (mg/kg-day)$^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Beef					
Aluminum	8.9E-01	NA[(d)]	NA	NA	
Anthracene	1.9E-08	NA	NA	NA	
Arsenic	6.4E-05	3.7E-09	1.5E+00	5.5E-09	
Barium	1.4E-05	NA	NA	NA	
Beryllium	2.9E-05	1.7E-09	4.3E+00	7.3E-09	
Cadmium	4.1E-07	NA	NA	NA	
Chloromethane	1.1E-11	6.2E-16	1.3E-02	8.1E-18	
Chromium	4.2E-05	NA	NA	NA	
Copper	5.3E-03	NA	NA	NA	
Lead	4.3E-05	NA	NA	NA	
Manganese	1.4E-02	NA	NA	NA	
c-PAHs, total	1.7E-06	9.9E-11	7.3E+00	7.3E-10	
PCBs, total	2.2E-06	1.3E-10	7.7E+00	9.8E-10	
Phenanthrene	3.8E-08	NA	NA	NA	
Pyrene	2.8E-06	NA	NA	NA	
RDX	1.9E-08	1.1E-12	1.1E-01	1.2E-13	
Thallium	3.6E-02	NA	NA	NA	
1,3,5-Trinitrobenzene	1.3E-09	NA	NA	NA	
2,4,6-Trinitrotoluene	3.2E-06	1.9E-10	3.0E-02	5.6E-12	
			Total CTE ILCR:	1.5E-08	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Beef					
Aluminum	8.9E-01	NA	NA	NA	
Anthracene	7.7E-08	NA	NA	NA	
Arsenic	6.4E-05	2.4E-08	1.5E+00	3.5E-08	
Barium	1.4E-05	NA	NA	NA	
Beryllium	2.9E-05	1.1E-08	4.3E+00	4.7E-08	
Cadmium	4.1E-07	NA	NA	NA	
Chloromethane	1.9E-11	7.1E-15	1.3E-02	9.2E-17	
Chromium	4.2E-05	NA	NA	NA	
Copper	5.3E-03	NA	NA	NA	
Lead	4.3E-05	NA	NA	NA	
Manganese	1.4E-02	NA	NA	NA	
c-PAHs, total	7.1E-06	2.6E-09	7.3E+00	1.9E-08	
PCBs, total	2.2E-06	8.1E-10	7.7E+00	6.2E-09	
Phenanthrene	2.1E-07	NA	NA	NA	
Pyrene	1.0E-05	NA	NA	NA	
RDX	1.9E-08	6.8E-12	1.1E-01	7.5E-13	
Thallium	3.6E-02	NA	NA	NA	
1,3,5-Trinitrobenzene	1.3E-09	NA	NA	NA	
2,4,6-Trinitrotoluene	3.2E-06	1.2E-09	3.0E-02	3.6E-11	
			Total RME ILCR:	1.1E-07	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classsified as carcinogens.
[e]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
[f]PCB 1248 and PCB 1254.

Table 5-209. Summary of Potential Systemic Effects for the Current Adult Beef Consumer of Cattle from Grazing Allotment 1

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Beef					
Aluminum	8.9E-01	2.2E-04	1.0E+00	2.2E-04	
Anthracene	1.1E-08	2.6E-12	3.0E-01	8.8E-12	
Arsenic	6.4E-05	1.6E-08	3.0E-04	5.2E-05	
Barium	1.4E-05	3.4E-09	7.0E-02	4.9E-08	
Beryllium	2.9E-05	7.2E-09	5.0E-03	1.4E-06	
Cadmium	4.1E-07	9.9E-11	1.0E-03	9.9E-08	
Chloromethane	1.1E-11	2.6E-15	4.0E-03	6.5E-13	
Chromium	4.2E-05	1.0E-08	5.0E-03	2.1E-06	
Copper	5.3E-03	1.3E-06	4.0E-02	3.3E-05	
Lead	4.3E-05	NA[d]	NA	NA	
Manganese	1.4E-02	3.5E-06	1.4E-01	2.5E-05	
c-PAHs, total[e]	5.2E-07	NA	NA	NA	
PCBs, total[f]	2.2E-06	5.4E-10	2.0E-05	2.7E-05	
Phenanthrene	2.2E-08	NA	NA	NA	
Pyrene	1.1E-06	2.6E-10	3.0E-02	8.8E-09	
RDX	1.9E-08	4.5E-12	3.0E-03	1.5E-09	
Thallium	3.6E-02	8.7E-06	8.0E-05	1.1E-01	
1,3,5-Trinitrobenzene	1.3E-09	3.1E-13	5.0E-05	6.1E-09	
2,4,6-Trinitrotoluene	3.2E-06	7.9E-10	5.0E-04	1.6E-06	
			Total CTE HI:	1.1E-01	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Beef					
Aluminum	8.9E-01	8.9E-04	1.0E+00	8.9E-04	
Anthracene	4.6E-08	4.6E-11	3.0E-01	1.5E-10	
Arsenic	6.4E-05	6.4E-08	3.0E-04	2.1E-04	
Barium	1.4E-05	1.4E-08	7.0E-02	2.0E-07	
Beryllium	2.9E-05	2.9E-08	5.0E-03	5.9E-06	
Cadmium	4.1E-07	4.1E-10	1.0E-03	4.1E-07	
Chloromethane	1.2E-11	1.2E-14	4.0E-03	2.9E-12	
Chromium	4.2E-05	4.2E-08	5.0E-03	8.4E-06	
Copper	5.3E-03	5.3E-06	4.0E-02	1.3E-04	
Lead	4.3E-05	NA	NA	NA	
Manganese	1.4E-02	1.4E-05	1.4E-01	1.0E-04	
c-PAHs, total	4.3E-06	NA	NA	NA	
PCBs, total	2.2E-06	2.2E-09	2.0E-05	1.1E-04	
Phenanthrene	1.3E-07	NA	NA	NA	
Pyrene	6.6E-06	6.6E-09	3.0E-02	2.2E-07	
RDX	1.9E-08	1.9E-11	3.0E-03	6.2E-09	
Thallium	3.6E-02	3.6E-05	8.0E-05	4.5E-01	
1,3,5-Trinitrobenzene	1.3E-09	1.3E-12	5.0E-05	2.5E-08	
2,4,6-Trinitrotoluene	3.2E-06	3.2E-09	5.0E-04	6.5E-06	
			Total RME HI:	4.5E-01	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.
[e]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
[f]PCB 1248 and PCB 1254.

Table 5-210. Summary of Potential Systemic Effects for the Current Child Beef Consumer of Cattle from Gazing Allotment 1

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Beef					
Aluminum	8.9E-01	4.8E-04	1.0E+00	4.8E-04	
Anthracene	1.9E-08	1.0E-11	3.0E-01	3.4E-11	
Arsenic	6.4E-05	3.5E-08	3.0E-04	1.2E-04	
Barium	1.4E-05	7.6E-09	7.0E-02	1.1E-07	
Beryllium	2.9E-05	1.6E-08	5.0E-03	3.2E-06	
Cadmium	4.1E-07	2.2E-10	1.0E-03	2.2E-07	
Chloromethane	1.1E-11	5.9E-15	4.0E-03	1.5E-12	
Chromium	4.2E-05	2.3E-08	5.0E-03	4.6E-06	
Copper	5.3E-03	2.9E-06	4.0E-02	7.2E-05	
Lead	4.3E-05	NA[d]	NA	NA	
Manganese	1.4E-02	7.8E-06	1.4E-01	5.5E-05	
c-PAHs, total[e]	1.7E-06	NA	NA	NA	
PCBs, total[f]	2.2E-06	1.2E-09	2.0E-05	6.0E-05	
Phenanthrene	3.8E-08	NA	NA	NA	
Pyrene	2.8E-06	1.5E-09	3.0E-02	5.1E-08	
RDX	1.9E-08	1.0E-11	3.0E-03	3.3E-09	
Thallium	3.6E-02	1.9E-05	8.0E-05	2.4E-01	
1,3,5-Trinitrobenzene	1.3E-09	6.8E-13	5.0E-05	1.4E-08	
2,4,6-Trinitrotoluene	3.2E-06	1.8E-09	5.0E-04	3.5E-06	
			Total CTE HI:	2.4E-01	100.0%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Beef					
Aluminum	8.9E-01	1.4E-03	1.0E+00	1.4E-03	
Anthracene	7.7E-08	1.2E-10	3.0E-01	3.9E-10	
Arsenic	6.4E-05	9.8E-08	3.0E-04	3.3E-04	
Barium	1.4E-05	2.2E-08	7.0E-02	3.1E-07	
Beryllium	2.9E-05	4.5E-08	5.0E-03	9.1E-06	
Cadmium	4.1E-07	6.3E-10	1.0E-03	6.3E-07	
Chloromethane	1.9E-11	3.0E-14	4.0E-03	7.4E-12	
Chromium	4.2E-05	6.5E-08	5.0E-03	1.3E-05	
Copper	5.3E-03	8.2E-06	4.0E-02	2.1E-04	
Lead	4.3E-05	NA	NA	NA	
Manganese	1.4E-02	2.2E-05	1.4E-01	1.6E-04	
c-PAHs, total	7.1E-06	NA	NA	NA	
PCBs, total	2.2E-06	3.4E-09	2.0E-05	1.7E-04	
Phenanthrene	2.1E-07	NA	NA	NA	
Pyrene	1.0E-05	1.6E-08	3.0E-02	5.2E-07	
RDX	1.9E-08	2.8E-11	3.0E-03	9.5E-09	
Thallium	3.6E-02	5.5E-05	8.0E-05	6.9E-01	
1,3,5-Trinitrobenzene	1.3E-09	1.9E-12	5.0E-05	3.9E-08	
2,4,6-Trinitrotoluene	3.2E-06	5.0E-09	5.0E-04	1.0E-05	
			Total RME HI:	6.9E-01	100.0%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.
[e]Benzo(a)pyrene-equivalent concentration of total carcinogenic PAHs.
[f]PCB 1248 and PCB 1254.

background level (see Table 5-206). No specific ingestion rates were available for offal in the western U.S., but it is estimated that consumption of organ meats comprises less than 0.5 percent of the total meat ingested (USDA 1993).

5.7.2 Risk Assessment Summary and Conclusions

A baseline risk assessment to evaluate consumption of beef through a regional and national distribution network was conducted for Grazing Allotment 1 based on Phase I and Phase II RI data. An RME and a CTE were evaluated for both adult and child consumers. All scenarios were found to fall well within or below the target ranges for tolerable ILCRs and HIs. Lead was evaluated separately based on agency guidance. Uptake of lead into beef muscle tissue was estimated to be at least three to four orders of magnitude below the value of 0.02 μg/g cited by USEPA (1986c) as a background level. No specific ingestion rates were available for offal in the western U.S., but it is estimated that consumption of organ meats comprises less than 0.5 percent of the total meat ingested (USDA 1993).

Based on the available analytical data and the above considerations, the risk assessment results indicate that there is no immediate and substantial danger to human health from the presence of low levels of hazardous chemicals on the grazing allotment. No further investigation based on considerations of human health is recommended.

6.0 OPERABLE UNIT 9

OU 9 consists of two sites in the western-most portion of TEAD-N: the Small Arms Firing Range (SWMU 8) and the AED Test Range (SWMU 40). SWMU 8 was used for training in the use of small arms. SWMU 40 was used for the testing of munitions and rocket engines, and for testing of the former Building 1236 Deactivation Furnace, which now consists of the foundation and three walls. This section presents the Phase I and Phase II RI results for the two SWMUs in this OU.

6.1 SMALL ARMS FIRING RANGE

6.1.1 Site Characteristics

The Small Arms Firing Range (see Figure 1-2) is located along the extreme western boundary of TEAD-N and has been used by the National Guard, Army Reserve, Navy, and TEAD military personnel for training in the use of small fire arms (e.g., M-16s, M-60 machine guns, and pistols). The range contains 20 firing stations with targets located at 25, 50, 100, and 200 meters. Bermed areas behind the targets are used to stop the rounds fired at the targets. Photographs of the sampling area are presented in Appendix C. The use of the small arms firing range was discontinued in 1994. A new small arms practice area was established in 1992 in the south-central portion of TEAD-N.

6.1.2 Previous Investigations and Phase I and Phase II RI Activities

No previous environmental investigations had been conducted at SWMU 8 prior to the Phase I RI field activities. Following the site visit by Rust E&I in October 1991, four composite surface-soil samples were collected to determine if contaminants had been released to soils as a result of the thousands of rounds of ammunition fired into the bermed areas behind the targets. The composite samples consisted of five aliquots taken over an approximate 100-square-foot area per sample. The five aliquots were combined and homogenized to form a composite sample. The resulting four composite samples were analyzed for metals (Figure 6-1). The original samples were analyzed for TCLP metals only. In December 1992, the same locations were resampled for total metals. The total metals versus TCLP metals results were used to help determine contaminant fate and transport through leaching in soils. The total metals analysis indicated that only lead exceeds background concentrations in berm soils. TCLP results indicated that there are leachable concentrations of barium, cadmium, lead, and mercury. However, only lead exceeds regulatory limits for TCLP. Additional surface- and subsurface-soil samples were needed to further define the nature and extent of metals contamination.

In July of 1994, Phase II RI field activities were performed by Rust E&I at this SWMU. Samples were collected from 15 auger holes (0.5 feet and 3 feet using a stainless-steel hand auger) and from 20 surface-soil locations. The samples collected using the auger are identified

by a number and a "SAB" prefix, with the location number followed by an "A" to designate that the sample was collected at 0.5 feet or a "B" to designate that the sample was collected at a depth of 3 feet below ground surface (bgs). Soils sampled at the 20 surface locations have a number with the "SAS" prefix. The majority of the sample sites were concentrated on the earthen berms down range of the two firing stations where bullet fragments and shell casings have been observed. Other samples were collected in the area 5 to 10 feet in front of the firing stations and over the central portion of the Small Arms Firing Range (Figure 6-2). All of the 50 soil samples collected were analyzed for total metals. Figure 6-3 is a schematic diagram showing various features that make up SWMU 8 and the location of Phase II samples in relationship to these features.

In the bermed areas behind the targets, one-half of the samples were sieved prior to being placed in the sample container. All even-numbered sample locations were sieved, whereas all odd-numbered sample locations were collected as-is. The even-numbered samples were sieved to determine whether the lead contaminants are present in the coarse or fine fraction of the soils. Sieving was accomplished using a rectangular piece of 1-mm square mesh made of common fiber glass window screen. The mesh was placed over the sampling pan, and the finer fraction that passed through the mesh was collected as the sample. The coarser fractions, which included whole or large fragments of bullets, were returned to the sampling location. The mesh was decontaminated between sample locations.

Due to debris observed in an area southwest of the back of the bullet stop (overshot), it was determined that additional surface- and subsurface-soil sampling was needed to evaluate the potential risks to human health and the environment from metals in soils at SWMU 8. In November 1995, the area southwest of the bullet stop was sampled for metals contamination. Twenty surface-soil samples (SAS-95-01 through-10 and SAB-95-01A through 10A) were collected over the area where metals debris from overshot was observed (Figure 6-4). In addition, subsurface-soil samples from depths ranging from 1.5 to 3 feet (variable depths due to hand auger refusal in cobble gravel) were collected (SAB-95-01B through-10B). All samples were analyzed for total metals.

6.1.3 Contamination Assessment

6.1.3.1 *Data Evaluation for Use in Risk Assessment*

This section evaluates the analytical data for its usability in the risk assessment. A data evaluation was performed by reviewing the data quality codes assigned by the USAEC Chemistry Branch and EcoChem, an independent third-party validator. In an effort to ascertain the level of certainty/uncertainty, USEPA data qualification codes were then assigned as an aid in interpreting the data for use in the risk assessment. (Table 2-4 defines the relationship between the USAEC Chemistry Branch codes and USEPA data qualifiers.) The following sections summarize the results of this process.

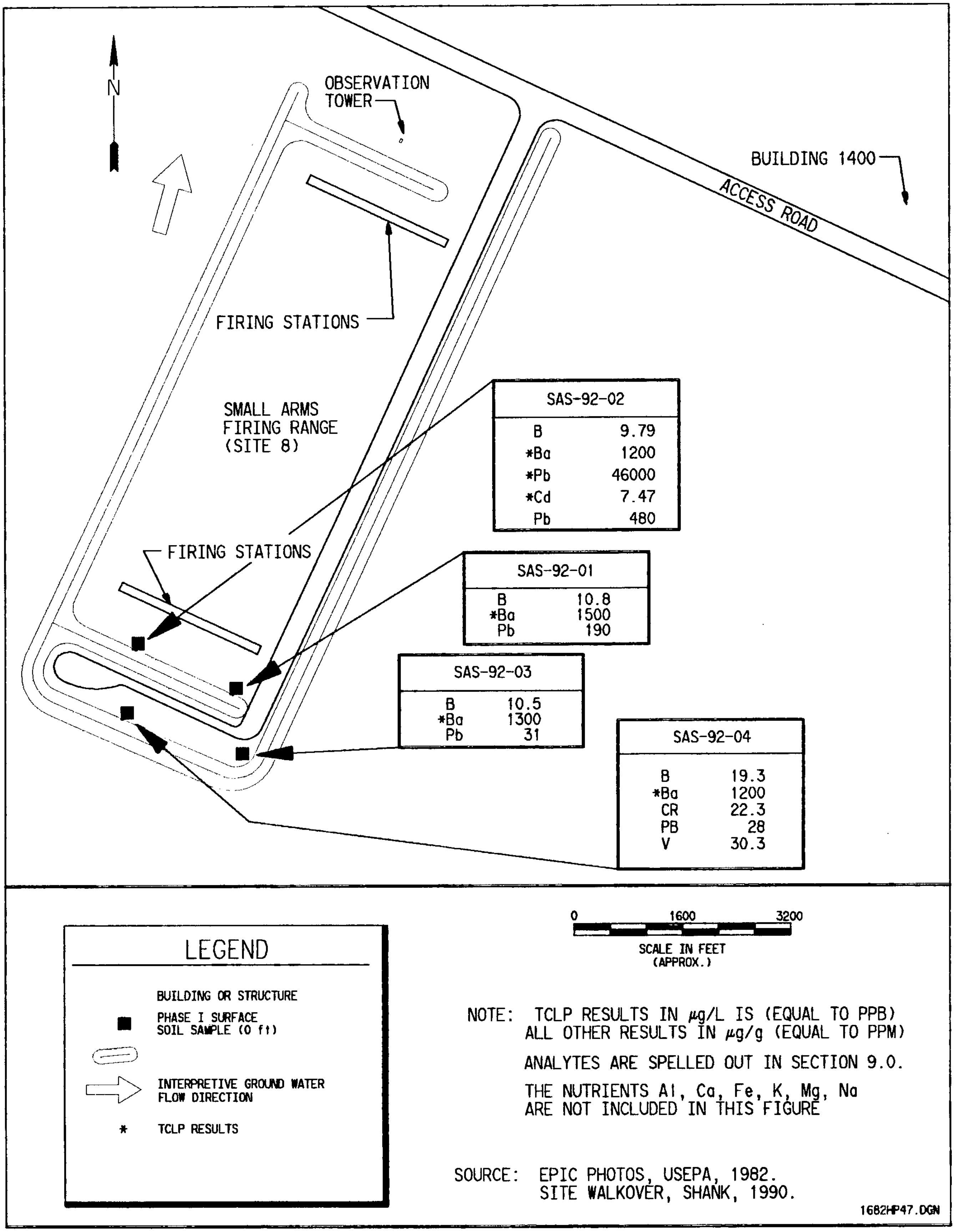

Figure 6-1. SWMU 8 Phase I Sample Locations and Results

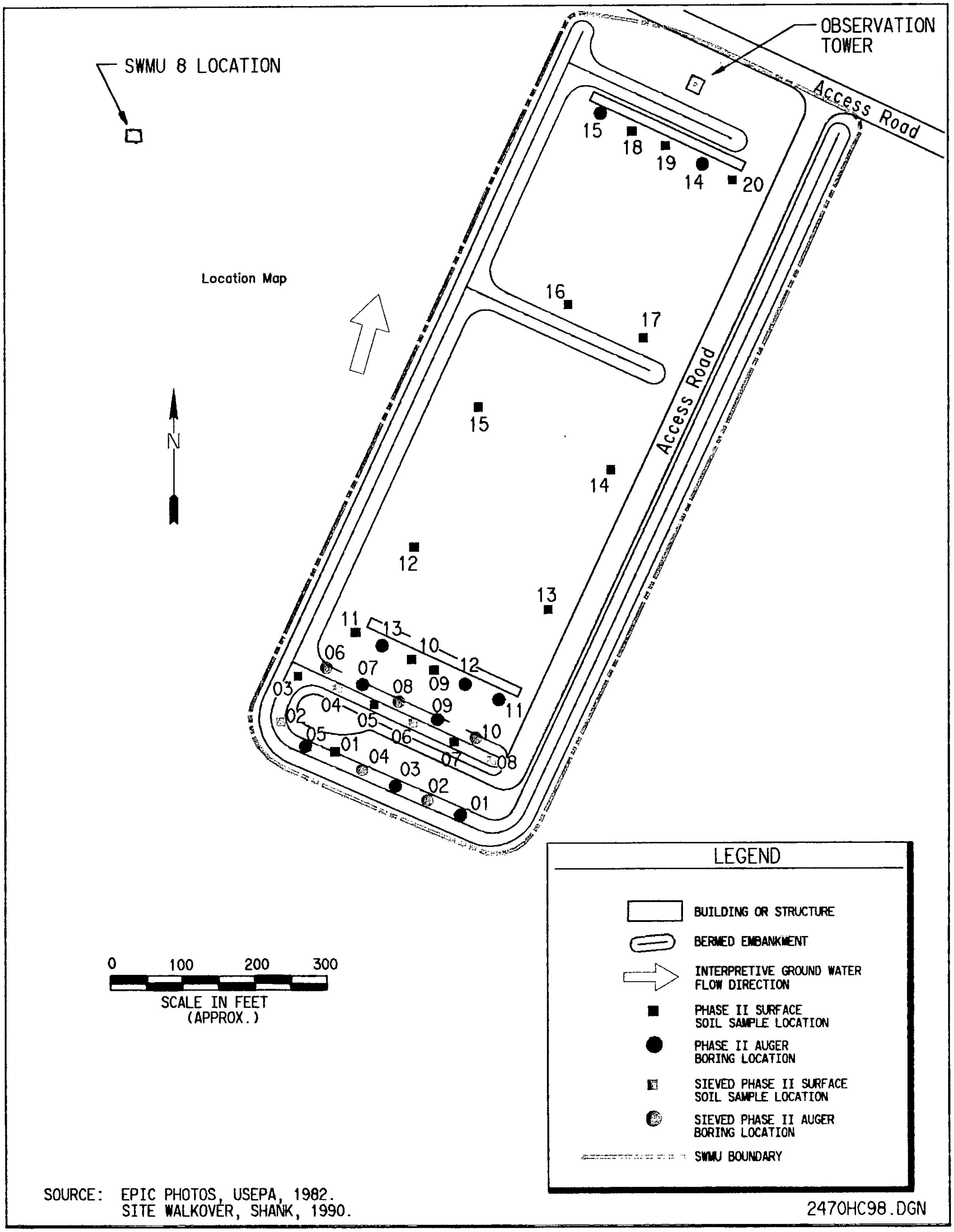

Figure 6-2. SWMU 8 Phase II Sample Locations

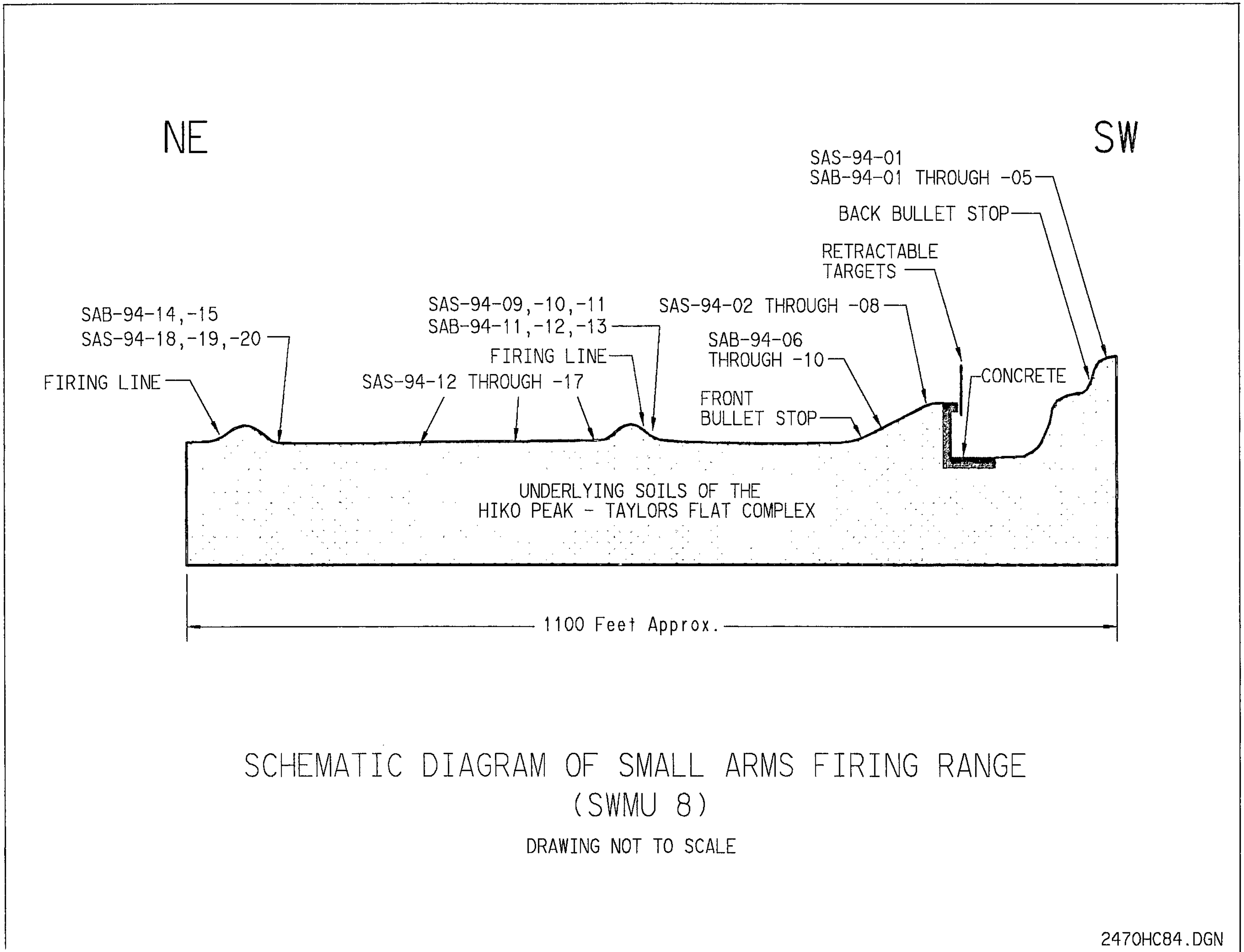

Figure 6-3. Cross Section of SWMU 8 and Locations of Phase II Samples

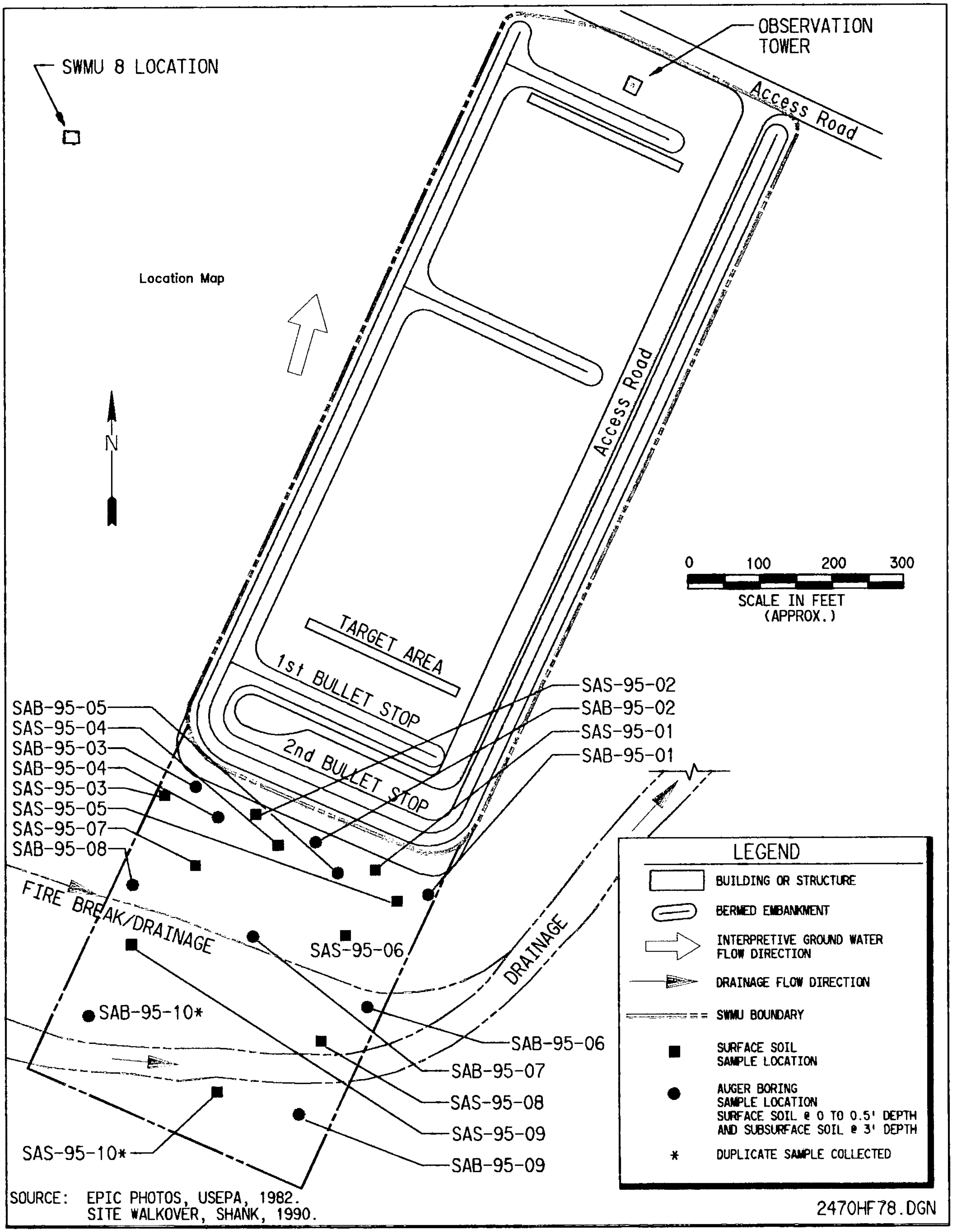

Figure 6-4. SWMU 8 Phase II Sample Locations for Area Beyond Bullet Stop

6.1.3.1.1 ***Field Duplicates.*** The "D" flag code represents a field duplicate. All "D" flagged data were compared with the primary investigative result, and the higher of the two values was used.

6.1.3.1.2 ***Blank Assessment.*** The USEPA has determined that when blank contamination exists, the investigative results must exceed the blank result by a factor of 5 (all compounds) or 10 (common laboratory contaminatants such as acetone) in order to be considered positive. Three metals were detected in method and or other blanks associated with SWMU 8 soil samples. Based on comparisons to blanks, the following positive results for metals were changed to nondetects. Per USEPA guidance (USEPA 1989), the associated blank concentration was considered to be the quantitation limit for the affected samples.

- Bullet Stops—Surface Soil
  -Vanadium—SAB094-10A and SAS-94-02

- Drainage Area—Subsurface Soil
  -Manganese—SAB-95-01B and -06B
  -Potassium—SAB-95-01B and -06B

6.1.3.1.3 USAEC Chemistry Branch Validation. The USAEC Chemistry Branch reviewed the analytical data for technical deficiencies based on the *USATHAMA (USAEC) Quality Assurance Program (PAM 11-41)*. USAEC data qualifiers assigned by the Chemistry Branch would be an indication of QC recoveries outside of USAEC control limits and other technical deficiencies. Estimating the data for use in the risk assessment based on USAEC data qualifiers is judged to be a conservative approach since USAEC control limits are generally narrower than USEPA Functional Guidelines. For SWMU 8, all data reviewed by the USAEC Chemistry Branch were found to be acceptable for use without qualification.

Non-Certified Compounds. USAEC flag codes of R or T were assigned by the analytical laboratory to indicate non-detected compounds that had not been performance demonstrated or validated under the USAEC's 1990 QA program. Under this program a distinction is made between "target" and "non-target" analytes. "Target" compounds are determined during the certification process, and CRLs for those analytes are established. "Non-target" compounds are those that were added to the method to meet project-specific requirements. The lowest calibration standard typically reflects the PQL for that analyte. For the purpose of the risk assessment, the detection limit will be assigned a J-code, due to the uncertainty associated with not having undergone a rigorous certification process.

6.1.3.1.4 ***Independent Third-Party Data Validation.*** For 1994 data, a data quality assessment was completed using a validation effort by EcoChem, an independent third party. EcoChem's review and recommendations were based on USEPA Functional Guidelines as well as the *USATHAMA (USAEC) Quality Assurance Program (PAM 11-41*) and individual

methods. All USEPA data qualifiers recommended by EcoChem were incorporated for use in the risk assessment and are provided in the analytical summary tables of Appendix J.

For SWMU 8, EcoChem evaluated one lot of mercury analyses of soil samples by Method Y9. All results were found to be acceptable for use without qualification.

As a result of the validation process, no SWMU 8 sample data were rejected for use in the risk assessment.

For 1995 data, one lot each of soil data and water data were reviewed by EcoChem for ICP metals analysis. No qualifiers were assigned to any of the data. No soil or water data for arsenic by GFAA were qualified. Two soil lots for antimony by GFAA were reviewed. All antimony soil detection limits were estimated UJ in lots AVYB and AVYC due to low percent recoveries in the MS/MSDs. No qualifiers were issued to water samples for arsenic analysis. All selenium results in lot AVXY (soil) were estimated (UJ) due to low percent recoveries in the associated MS/MSDs. All selenium results in lot AVZD (water) were estimated UJ due to low percent recovery values in the low spike analysis. Two soil lots of thallium by GFAA were reviewed. All thallium detection limits were estimated (UJ) due to low percent recovery values in the associated laboratory control samples. One lot of thallium in water was reviewed and no qualifiers were assigned. All positive mercury results for lot AVYQ (soil) were estimated J due to high percent recoveries in the low spike analysis. No qualifiers were assigned to the data associated with the single water lot for mercury analysis. No data were rejected.

6.1.3.1.5 ***Data Evaluation Summary.*** A total of 59 surface soil samples (and 5 duplicates) and 25 subsurface soil samples (and 1 duplicate) were collected in 1992, 1994, and 1995 from 25 soil borings and 34 surface locations at SWMU 8. Soil boring samples were collected at depths of 0.5 and 3 feet. With the exception of four 1992 composite samples analyzed for TCLP metals, all samples were analyzed for total metals only.

The four surface samples collected in 1992 were composites of five subsamples each. Compositing may lead to underestimation of the magnitude of contamination. Additionally, all 1994 even-numbered sample locations were sieved, while all odd-numbered locations were collected as-is. This lack of comparability of samples contributes to uncertainty in the statistical calculations used in the risk assessment.

Because of blank contamination, positive results for manganese, vanadium, and potassium were changed to nondetects for a few samples. However, the detected values in the affected samples were below background screening levels for the metals, indicating that this issue would not significantly impact the risk assessment results.

Antimony reporting limits for samples collected in 1992 and 1994 (19.6 μg/g) exceeded the background screening value (15 μg/g), making it difficult to characterize the distribution of above background concentrations for this analyte. The few antimony detections ranged from 41.2 to 143 μg/g. The antimony reporting limit was 1 μg/g for 1995 samples, all of which were collected in the drainage area. There were no antimony detects in 1995 samples. The PRGs calculated by Dames and Moore (1996) (136 to 467 μg/g) for current land use

conditions are generally higher than the above-noted detection limits and detections. Therefore, no data gap exists under current conditions. Additional sampling would be necessary prior to pursuing any future residential land use.

Cadmium and silver were each detected in only two surface soil samples. Although, the reporting limits for these metals exceed their background screening values, they are less than their respective ingestion and soil-to-air RBCs. Therefore, this issue does not significantly impact the risk assessment results for these metals.

Thallium was not detected in any sample at this SMWU. The thallium reporting limits exceed the background screening value (11.7 μg/g) and the ingestion RBC (0.6 μg/g) for the 1992 and 1994 samples. However, the current use PRG for thallium (98.1 to 1,330 μg/g) (Dames and Moore 1996) is much higher than the elevated reporting limits, eliminating data gap concerns. It is important to note that additional sampling may be necessary prior to pursuing any future residential land use. The 1995 samples, collected in the drainage area, had a reporting limit of 1 μg/g.

No data from SWMU 8 were rejected. All of the sample results were judged to be usable for risk assessment purposes. The number of samples and the analytical parameter list appear to be sufficient to characterize the nature, extent, and potential magnitude of contamination at this SWMU with exceptions noted above. A summary of chemicals detected in at least one surface or subsurface soil sample at SWMU 8 is presented in Appendix J, including corresponding data qualifiers (where appropriate) based on USEPA functional guidelines.

6.1.3.1.6 ***Background Screening.*** The maximum concentrations of inorganic chemicals detected in soil at SWMU 8 were compared to the site-specific background screening values (see Section 2.6). Any inorganic chemical detected in at least one sample at a concentration higher than the background screening value was retained in the COPC database. The data were first divided into the four major sampling areas: the bullet stops, the firing lines, the area between the firing lines, and the drainage area. Surface soil and subsurface soil were screened separately. The results of the background screening are shown in Table 6-1.

Bullet Stops. Antimony, arsenic, barium, chromium, cobalt, copper, iron, lead, magnesium, mercury, nickel, silver, sodium, vanadium, and zinc exceeded background screening values in surface soils at the bullet stops. In subsurface soils, barium, chromium, cobalt, copper, iron, lead, magnesium, mercury, nickel, sodium, and vanadium exceeded background screening values.

Firing Lines. In surface soil at the firing lines, barium, chromium, cobalt, iron, lead, magnesium, mercury, nickel, sodium, and vanadium exceeded background screening values. In subsurface soil, chromium, cobalt, iron, lead, magnesium, nickel, selenium, sodium, and vanadium exceeded background screening values.

Area Between Firing Lines. In surface soil, chromium, cobalt, lead, magnesium, nickel, and vanadium exceeded background screening values. No subsurface samples were collected in the area between the firing lines.

Drainage Area. In the drainage area surface soils, aluminum, barium, cadmium, chromium, cobalt, iron, lead, magnesium, nickel, potassium, selenium, sodium, vanadium, and zinc exceeded background screening values. Barium, chromium, cobalt, iron, lead, magnesium, mercury, nickel, potassium, sodium, and vanadium exceeded background screening values in subsurface soil.

In both site-wide surface and subsurface soils, the antimony CRLs (19.6 μg/g) exceeded background (15 μg/g) for all nondetects for samples collected in 1992 and 1994. However, the antimony CRL for 1995 samples was 1.0 μg/g, and no antimony was detected in these samples. Cadmium was not detected in surface or subsurface soils, but the CRL (1.2 μg/g) exceeded the background screening value of 0.847 μg/g. Silver was detected in only two surface soil samples. The CRL for silver (0.803 μg/g) exceeded the background screening value of 0.66 μg/g.

6.1.3.2 *Summary of Analytical Results*

The list of analytes detected in at least one surface or subsurface soil example is provided in Tables 6-2 and 6-3 for Phase I data and in Table 6-4 for Phase II data.

6.1.3.3 *Nature and Extent of Contamination*

Figure 6-3 presents a cross section of the sampling locations of the site. Auger locations SAB-94-01 through SAB-94-05 and surface soil location SAS-01 are located along the back bullet stop, and represent the topographic high of the sampling areas. Surface locations SAS-94-02 and SAS-94-03 are located along the side of the bullet stop, in an area that runs parallel to the firing line. Surface locations SAS-94-04 through SAS-94-08 are along the top of the front bullet stop; while boring locations SAB-94-06 through SAB-94-10 are along the face of the front bullet stop. Surface locations SAS-94-09, SAS-94-10, and SAS-94-11 in addition to boring locations SAB-94-11, SAB-94-12, and SAB-94-13 represent soils beneath the first firing line. Borings SAB-94-14 and SAB-94-15 with surface locations SAS-94-18, SAS-94-19, and SAS-94-20 are associated with the second firing line. Surface locations SAS-94-12 through SAS-94-17 represent surface soils across the middle of the site, between the two firing lines. Surface locations SAS-95-01 through SAS-95-10 represent soils associated with an area containing drainages and debris from overshot behind the bullet stops. Borings SAB-95-04 through SAB-95-10 represent boring locations in the drainage area to evaluate subsurface soils to a depth of 3 feet.

Soils collected at the two bullet stop sampling areas contained higher metal concentrations compared to the soils collected in the vicinity of the firing lines and the central portion of the range. The back bullet stop contained the highest lead concentrations from the Phase II samples compared to the other areas of the site. Based on the TCLP analysis of Phase I samples, the highest lead concentration (46,000 μg/L) was encountered in a composite sample (SAS-92-02) collected from the front bullet stop. All Phase II analytical results for soils collected across the site are included in Table 6-4. The following sections describe the nature and extent of contamination in each of the four sample areas. Analytical results for each Phase II sample location are shown in Figures 6-5 through 6-8.

Table 6-1. Background Screening of Inorganic Chemicals Detected in Soil at SWMU 8

Chemical	Frequency of Detection[a]	Maximum Detected Value (μg/g)[b]	Site-specific Background Screening Value[c] (μg/g)	Exceeds Site-specific Background?
Bullet Stops - Surface Soil				
Aluminum	22/22	26,600	28,083	No
Antimony	5/22	143	15.0	YES
Arsenic	22/22	27.0	11.69	YES
Barium	22/22	293	247	YES
Beryllium	18/22	1.27	1.46	No
Calcium	22/22	84,000	114,483	No
Chromium	22/22	28.3	20.62	YES
Cobalt	21/22	10.2	6.94	YES
Copper	22/22	1,700	24.72	YES
Iron	22/22	26,900	22,731	YES
Lead	22/22	33,000	18.23	YES
Magnesium	22/22	13,600	7,062	YES
Manganese	22/22	625	698	No
Mercury	3/22	0.063	0.0572	YES
Nickel	22/22	20.2	17.40	YES
Potassium	22/22	5,050	5,450	No
Silver	2/22	1.22	0.66	YES
Sodium	22/22	1,090	337	YES
Vanadium	20/22	35.2	28.39	YES
Zinc	22/22	213	102.8	YES
Bullet Stops - Subsurface Soil				
Aluminum	10/10	20,600	28,083	No
Arsenic	10/10	8.47	11.69	No
Barium	10/10	252	247	YES
Beryllium	10/10	1.01	1.46	No
Calcium	10/10	55,900	114,483	No
Chromium	10/10	28.6	20.62	YES
Cobalt	10/10	8.62	6.94	YES
Copper	10/10	70.4	24.72	YES
Iron	10/10	25,400	22,731	YES
Lead	10/10	1,500	18.23	YES
Magnesium	10/10	14,500	7,062	YES
Manganese	10/10	471	698	No
Mercury	2/10	0.064	0.0572	YES
Nickel	10/10	20.1	17.40	YES
Potassium	10/10	4,290	5,450	No
Sodium	10/10	1,150	337	YES

Table 6-1. Background Screening of Inorganic Chemicals Detected in Soil at SWMU 8 (continued)

Chemical	Frequency of Detection[a]	Maximum Detected Value (μg/g)[b]	Site-specific Background Screening Value[c] (μg/g)	Exceeds Site-specific Background?
Vanadium	10/10	41.4	28.39	**YES**
Zinc	10/10	82.5	102.8	No
Firing Lines - Surface Soil				
Aluminum	11/11	20,600	28,083	No
Arsenic	11/11	9.07	11.69	No
Barium	11/11	295	247	**YES**
Beryllium	11/11	1.14	1.46	No
Calcium	11/11	58,000	114,483	No
Chromium	11/11	25.5	20.62	**YES**
Cobalt	11/11	10.2	6.94	**YES**
Copper	11/11	20.7	24.72	No
Iron	11/11	27,400	22,731	**YES**
Lead	11/11	67.3	18.23	**YES**
Magnesium	11/11	13,600	7,062	**YES**
Manganese	11/11	661	698	No
Mercury	1/11	0.068	0.0572	**YES**
Nickel	11/11	24.0	17.40	**YES**
Potassium	11/11	4,750	5,450	No
Sodium	11/11	513	337	**YES**
Vanadium	11/11	33.6	28.39	**YES**
Zinc	11/11	93.6	102.8	No
Firing Lines - Subsurface Soil				
Aluminum	5/5	21,900	28,083	No
Arsenic	5/5	9.87	11.69	No
Barium	5/5	197	247	No
Beryllium	4/5	1.07	1.46	No
Calcium	5/5	50,800	114,483	No
Chromium	5/5	40.2	20.62	**YES**
Cobalt	5/5	8.06	6.94	**YES**
Copper	5/5	17.0	24.72	No
Iron	5/5	22,900	22,731	**YES**
Lead	5/5	19.3	18.23	**YES**
Magnesium	5/5	13,000	7,062	**YES**
Manganese	5/5	453	698	No
Nickel	5/5	23.2	17.40	**YES**
Potassium	5/5	4,290	5,450	No
Selenium	1/5	1.93	0.449	**YES**
Sodium	5/5	839	337	**YES**

Table 6-1. Background Screening of Inorganic Chemicals Detected in Soil at SWMU 8 (continued)

Chemical	Frequency of Detection[a]	Maximum Detected Value (μg/g)[b]	Site-specific Background Screening Value[c] (μg/g)	Exceeds Site-specific Background?
Vanadium	5/5	36.9	28.39	YES
Zinc	5/5	75.0	102.8	No
Between Firing Lines - Surface Soil				
Aluminum	6/6	18,900	28,083	No
Arsenic	6/6	10.1	11.69	No
Barium	6/6	234	247	No
Beryllium	6/6	0.938	1.46	No
Calcium	6/6	59,000	114,483	No
Chromium	6/6	23.0	20.62	YES
Cobalt	6/6	8.86	6.94	YES
Copper	6/6	21.6	24.72	No
Iron	6/6	22,600	22,731	No
Lead	6/6	55.5	18.23	YES
Magnesium	6/6	13,700	7,062	YES
Manganese	6/6	527	698	No
Mercury	1/6	0.054	0.0572	No
Nickel	6/6	18.7	17.40	YES
Potassium	6/6	5,090	5,450	No
Sodium	6/6	331	337	No
Vanadium	6/6	30.4	28.39	YES
Zinc	6/6	88.6	102.8	No
Drainage Area - Surface Soil				
Aluminum	20/20	28,800	28,083	YES
Arsenic	20/20	10.1	11.69	No
Barium	20/20	365	247	YES
Beryllium	20/20	1.3	1.46	No
Cadmium	2/20	1.43	0.847	YES
Calcium	20/20	53,000	114,483	No
Chromium	20/20	27.7	20.62	YES
Cobalt	20/20	10.1	6.94	YES
Copper	20/20	23.9	24.72	No
Iron	20/20	28,000	22,731	YES
Lead	20/20	45.4	18.23	YES
Magnesium	20/20	14,100	7,062	YES
Manganese	20/20	544	698	No
Mercury	3/20	0.057	0.0572	No
Nickel	20/20	22.5	17.40	YES
Potassium	20/20	6,260	5,450	YES

Table 6-1. Background Screening of Inorganic Chemicals Detected in Soil at SWMU 8 (continued)

Chemical	Frequency of Detection[a]	Maximum Detected Value (μg/g)[b]	Site-specific Background Screening Value[c] (μg/g)	Exceeds Site-specific Background?
Selenium	1/20	0.493	0.449	YES
Sodium	20/20	2,250	337	YES
Vanadium	20/20	37.7	28.39	YES
Zinc	20/20	109	102.8	YES
Drainage Area - Subsurface Soil				
Aluminum	10/10	24,700	28,083	No
Arsenic	9/10	8.09	11.69	No
Barium	10/10	266	247	YES
Beryllium	8/10	1.12	1.46	No
Calcium	10/10	70,000	114,483	No
Chromium	10/10	28.9	20.62	YES
Cobalt	10/10	8.50	6.94	YES
Copper	10/10	21.4	24.72	No
Iron	10/10	25,400	22,731	YES
Lead	8/10	26.0	18.23	YES
Magnesium	10/10	14,500	7,062	YES
Manganese	8/10	560	698	No
Mercury	2/10	0.082	0.0572	YES
Nickel	10/10	20.4	17.40	YES
Potassium	8/10	6,680	5,450	YES
Sodium	10/10	1,970	337	YES
Vanadium	10/10	40.4	28.39	YES
Zinc	10/10	101	102.8	No

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]Micrograms per gram.
[c]See Section 2.6.1.1 for an explanation of how the site-specific background screening values were calculated.

Table 6-2. Summary of Total Metals Detected in Soil for the Small Arms Firing Range (SWMU 08) - Phase I

Group	Analytes	Background Concentrations	SAS-92-01 (0ft)	SAS-92-02 (0ft)	SAS-92-03 (0ft)	SAS-92-04 (0ft)
METALS	ALUMINUM	28083	14000	13100	15100	19200
	ARSENIC	11.69	5.72	7.34	10.8	8.47
	BARIUM	247.1	183	199	185	185
	BERYLLIUM	1.455	0.571	0.495	0.542	0.597
	BORON	N/A	**10.8***	**9.79***	**10.5***	**19.3***
	CALCIUM	114483	84000	47300	35200	31200
	CHROMIUM	20.62	16	14.6	18.1	**22.3***
	COBALT	6.94	4.91	6.28	6.22	6.4
	COPPER	24.72	18.8	14.6	13.1	17.8
	IRON	22731	15300	17100	18500	20200
	LEAD	18.23	**190***	**480***	**31***	**28***
	MAGNESIUM	7061	**8720***	**10100***	**9000***	**10800***
	MANGANESE	698.3	307	308	441	405
	NICKEL	17.4	13.8	14.2	16.6	15.6
	POTASSIUM	5449	2690	2710	3990	5050
	SODIUM	337	247	289	275	**358***
	VANADIUM	28.39	21.4	20.8	26.2	**30.3***
	ZINC	102.8	52.9	53.9	62.4	71.7

Note.- All values in $\mu g/g$ (equal to ppm).

N/A=Not Applicable.

*=Organic analyte detected above CRL or MDL or detected inorganic analyte exceeding background.

Table 6-3. Summary of TCLP Metals Detected at the Small Arms Firing Range (SWMU 08) - Phase I

Group	Analytes	SAS-92-01 (0ft)	SAS-92-02 (0ft)	SAS-92-03 (0ft)	SAS-92-04 (0ft)
METALS	BARIUM	1500*	1200*	1300*	1200*
	CADMIUM	LT 27	7.47*	LT 2.67	LT 27
	LEAD	LT 410	46000*	LT 40.6	LT 410

Note.- All values in μg/l (equal to ppb).

*=Organic analyte detected above CRL or MDL.

LT=Analyte concentration is less than CRL , the CRL is posted next to the "LT".

Table 6-4. Summary of Analytes Detected in Soil for the Small Arms Firing Range (SWMU 8) - Phase II

Bullet Stops (Surface Soil)

Group	Analytes	Background Concentrations	SAB-94-01A (0.5ft)	SAB-94-02A (0.5ft)	SAB-94-03A (0.5ft)	SAB-94-04A (0.5ft)	SAB-94-05A (0.5ft)	SAB-94-06A (0.5ft)	SAB-94-07A (0.5ft)	SAB-94-08A (0.5ft)	SAB-94-09A (0.5ft)	SAB-94-10A (0.5ft)	SAS-94-01 (0.5ft)	SAS-94-02 (0.5ft)	SAS-94-03 (0.5ft)
METALS	ALUMINUM	28083	10700	10100	9950	6130	15200	17300	16200	14700	6020	4400	12200	5900	11900
	ANTIMONY	15	LT 19.6	143*	62.1*	LT 19.6	LT 19.6	LT 19.6	LT 19.6	97.2*	41.2*	LT 19.6	42.3*	LT 19.6	LT 19.6
	ARSENIC	11.69	7.41	27*	13.9*	7.72	7.1	8.9	8.81	12.5*	7.41	5.77	11.9*	6.38	6.5
	BARIUM	247.1	129	119	120	75.3	203	215	180	192	74.5	62.1	133	77.8	152
	BERYLLIUM	1.455	0.581	0.548	0.517	LT 0.427	0.85	0.835	0.839	0.792	LT 0.427	LT 0.427	0.639	LT 0.427	0.687
	CALCIUM	114483	40000	36800	34800	27800	45900	45900	62000	44900	25300	30100	42600	31200	43400
	CHROMIUM	20.62	12.9	13	12.6	7.99	17.5	20	18.8	17	8.2	6.27	15	8.59	16.1
	COBALT	6.94	5.29	4.35	4.34	4	7.34*	6.48	7*	6.06	3.34	LT 2.5	5.99	3.84	6.14
	COPPER	24.72	10.7	1700*	335*	29.1*	15.6	20.8	178*	879*	89*	9.25	243*	14.5	15.4
	IRON	22731	15900	13700	13500	10600	20200	19800	19400	18900	11600	9100	16700	10500	18000
	LEAD	18.23	12.9	33000*	15000*	788*	545*	1200*	5900*	26000*	7100*	117*	12000*	102*	39.1*
	MAGNESIUM	7061	9880*	8860*	8100*	5390	12200*	11500*	10900*	11500*	5430	5660	10400*	6440	11900*
	MANGANESE	698.3	317	267	270	167	413	374	374	376	172	147	312	196	371
	MERCURY	0.0572	0.0518	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	0.0627*	LT 0.05	LT 0.05	LT 0.05	0.0537
	NICKEL	17.4	12.3	10.9	11.2	8.47	14.7	15	15.1	15.5	7.73	7.18	11.5	7.04	13.9
	POTASSIUM	5449	1710	1790	2020	1190	2150	2910	2810	2760	1030	746	2210	1120	2190
	SILVER	0.66	LT 0.803	1.22*	LT 0.803	LT 0.803	LT 0.803	LT 0.803	LT 0.803	0.884*	LT 0.803	LT 0.803	LT 0.803	LT 0.803	LT 0.803
	SODIUM	337	310	291	342*	171	382*	426*	426*	459*	229	215	188	92.7	183
	VANADIUM	28.39	20.1	17.8	16.8	10.9	25.9	28.8	25	23.3	11.4	8.56#	20	11.7#	21.6
	ZINC	102.8	42.7	213*	82.7	24.5	58.1	62.3	81.8	157*	34	19.7	73.6	26.9	56.1

Group	Analytes	Background Concentrations	SAS-94-04 (0.5ft)	SAS-94-04(D) (0.5ft)	SAS-94-05 (0.5ft)	SAS-94-06 (0.5ft)	SAS-94-07 (0.5ft)	SAS-94-08 (0.5ft)
METALS	ALUMINUM	28083	15300	19000	17000	23000	26600	17600
	ANTIMONY	15	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6
	ARSENIC	11.69	6.55	6.9	7.51	6.53	6.89	6.91
	BARIUM	247.1	199	201	209	250*	293*	215
	BERYLLIUM	1.455	0.856	0.917	0.941	1.07	1.27	0.982
	CALCIUM	114483	44900	43800	45700	45400	38100	48700
	CHROMIUM	20.62	18.3	22.1*	19.3	25.3*	28.3*	20.6
	COBALT	6.94	7.71*	7.98*	7.91*	8.64*	10.2*	8.26*
	COPPER	24.72	15.6	16.5	16.7	18.4	28.9*	16.8
	IRON	22731	20300	21700	21800	24100*	26900*	22000
	LEAD	18.23	45.5*	71.6*	204*	60.5*	205*	51.3*
	MAGNESIUM	7061	12000*	12200*	12500*	13600*	13400*	13200*
	MANGANESE	698.3	405	405	438	434	625	438
	MERCURY	0.0572	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	15.4	16.3	17.2	18.8*	20.2*	16.8
	POTASSIUM	5449	2460	3030	2730	3810	3940	2830
	SILVER	0.66	LT 0.803	LT 0.803	LT 0.803	LT 0.803	LT 0.803	LT 0.803
	SODIUM	337	1030*	1090*	552*	572*	857*	523*
	VANADIUM	28.39	24.3	29*	25.3	32.8*	35.2*	27
	ZINC	102.8	64.5	67.1	70.7	78	89.4	71.4

Table 6-4. Summary of Analytes Detected in Soil for the Small Arms Firing Range (SWMU 8) - Phase II (continued)

Firing Lines (Surface Soil)

Group	Analytes	Background Concentrations	SAB-94-11A (0.5ft)	SAB-94-12A (0.5ft)	SAB-94-13A (0.5ft)	SAB-94-14A (0.5ft)	SAB-94-15A (0.5ft)	SAS-94-09 (0.5ft)	SAS-94-09(D) (0.5ft)	SAS-94-10 (0.5ft)	SAS-94-11 (0.5ft)	SAS-94-18 (0.5ft)	SAS-94-19 (0.5ft)	SAS-94-19(D) (0.5ft)	SAS-94-20 (0.5ft)
METALS	ALUMINUM	28083	12400	18200	20400	20000	18700	20600	19100	12700	16600	17000	17800	16600	16200
	ARSENIC	11.69	5.37	6.41	9.07	6.65	6.03	6.56	7.03	8.24	6.83	8.68	7.24	7.24	7.01
	BARIUM	247.1	156	161	295*	227	205	222	228	171	173	197	218	211	199
	BERYLLIUM	1.455	0.701	0.983	1.14	0.922	0.969	0.961	0.938	0.717	0.796	0.893	0.906	0.922	0.861
	CALCIUM	114483	38400	28000	45400	43000	47600	46700	47200	50300	47800	42900	58000	53500	49400
	CHROMIUM	20.62	15.4	19.5	23.4*	25.5*	23.3*	23.7*	21.5*	17.3	19.4	19.9	21.6*	19.7	20.3
	COBALT	6.94	5.62	7.93*	10.2*	7.47*	7.98*	7.93*	8.21*	6.76	7.17*	8.11*	7.83*	7.94*	7.36*
	COPPER	24.72	11.6	19	19.7	16.2	16.5	16	18	18	16.5	15.9	17.4	16.5	20.7
	IRON	22731	18000	21800	27400*	22700	23100*	23000*	22400	19200	19700	22400	22300	21300	20600
	LEAD	18.23	18.8*	33.8*	25.5*	19.1*	19.2*	20.1*	20*	67.3*	33.1*	17.9	18.7*	18.1	17
	MAGNESIUM	7061	11500*	10700*	13600*	12200*	13200*	12900*	12800*	11200*	12400*	11900*	13500*	13200*	11900*
	MANGANESE	698.3	409	384	661	398	393	436	455	418	415	429	412	413	394
	MERCURY	0.0572	LT 0.05	0.0684*	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	13	18.4*	24*	18.2*	18.2*	17	16	16.2	14.8	17.4	18.8*	17.6*	15.9
	POTASSIUM	5449	1910	2890	3220	4300	3850	3170	2970	2390	2840	3120	3580	3320	4750
	SODIUM	337	407*	496*	513*	428*	503*	454*	436*	373*	424*	233	356*	339*	266
	VANADIUM	28.39	21.1	24.8	31.6*	33.6*	32.6*	32.1*	30.2*	22.5	24.7	26.1	29*	25.5	25.5
	ZINC	102.8	51.9	73	93.6	74.4	75.7	71.1	70.3	66.2	66.1	72.2	75.8	73.5	73.4

Area Between Firing Lines (Surface Soil)

Group	Analytes	Background Concentrations	SAS-94-12 (0.5ft)	SAS-94-13 (0.5ft)	SAS-94-14 (0.5ft)	SAS-94-15 (0.5ft)	SAS-94-16 (0.5ft)	SAS-94-17 (0.5ft)
METALS	ALUMINUM	28083	18900	11200	18000	9980	17600	16000
	ARSENIC	11.69	6.35	7.5	10.1	7.74	9.65	6.71
	BARIUM	247.1	234	155	193	150	200	175
	BERYLLIUM	1.455	0.938	0.597	0.877	0.591	0.887	0.771
	CALCIUM	114483	49400	52700	26900	59000	42000	28300
	CHROMIUM	20.62	20.9*	16.1	23*	14.8	22.9*	20.9*
	COBALT	6.94	8.86*	6.32	7.81*	6.34	8.11*	7*
	COPPER	24.72	16.4	14.4	19.1	15.3	18.7	21.6
	IRON	22731	22400	18200	22600	17300	22100	20300
	LEAD	18.23	21.7*	49.9*	25.7*	55.5*	20.9*	20.4*
	MAGNESIUM	7061	13700*	12900*	11100*	11800*	13200*	13500*
	MANGANESE	698.3	341	365	513	371	446	527
	MERCURY	0.0572	LT 0.05	0.0536	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	17.5*	13.8	18.7*	14.1	17.8*	13.7
	POTASSIUM	5449	3720	2140	4370	2260	4330	5090
	SODIUM	337	331	223	272	191	277	309
	VANADIUM	28.39	26.6	23.3	30.4*	21.3	28	26.7
	ZINC	102.8	76.5	60	88.6	58.3	86.8	87

Table 6-4. Summary of Analytes Detected in Soil for the Small Arms Firing Range (SWMU 8) - Phase II (continued)

Drainage Area (Surface Soil)

Group	Analytes	Background Concentrations	SAB-95-01A (0.5ft)	SAB-95-02A (0.5ft)	SAB-95-03A (0.5ft)	SAB-95-04A (0.5ft)	SAB-95-05A (0.5ft)	SAB-95-06A (0.5ft)	SAB-95-07A (0.5ft)	SAB-95-08A (0.5ft)	SAB-95-09A (0.5ft)	SAB-95-10A (0.5ft)	SAB-95-10A(D) (0.5ft)	SAS-95-01 (0.5ft)	SAS-95-02 (0.5ft)
METALS	ALUMINUM	28083	14100	20500	20200	22100	19500	17500	19400	21700	15300	11800	12400	21000	20200
	ARSENIC	11.69	8.63	6.13	9.4	8.75	9.26	10.1	6.34	6.66	7.96	7.87	7.64	8.66	6.8
	BARIUM	247.1	160	248*	220	224	216	242	216	217	180	146	147	238	241
	BERYLLIUM	1.455	0.613	0.915	0.983	1.01	0.871	0.846	0.845	0.87	0.805	0.556	0.524	0.976	0.94
	CADMIUM	0.847	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2
	CALCIUM	114483	31600	53000	36700	38100	42000	37500	43100	40900	34200	34800	36200	47300	48000
	CHROMIUM	20.62	19.8	23.5*	24.1*	26.4*	24.4*	24.5*	23.6*	25.5*	19.5	20.3	21.5*	24.7*	23.6*
	COBALT	6.94	6.29	7.32*	7.66*	8.45*	7.92*	7.79*	7.01*	7.91*	7.56*	5.03	5.35	7.94*	8.11*
	COPPER	24.72	15	17	20.9	20.1	18.1	17.9	17.6	18.9	16.9	13	12.8	20.8	19.3
	IRON	22731	17800	21100	22800*	23800*	22100	21100	21400	22600	19700	17400	17500	22600	22700
	LEAD	18.23	21.5*	17.5	22.3*	19.6*	23.3*	17.5	20*	17	19.2*	16.4	13	45.4*	19*
	MAGNESIUM	7061	10400*	14100*	13200*	14000*	11900*	11600*	12400*	13400*	11500*	9530*	9910*	13700*	13700*
	MANGANESE	698.3	370	524	478	528	438	445	429	440	426	326	325	523	505
	MERCURY	0.0572	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	14.2	16.9	18.2*	18.9*	18.5*	18.6*	17.9*	18.5*	17.4	12.6	12	19.2*	18.2*
	POTASSIUM	5449	3560	5550*	5370	6060*	4310	4750	4690	6260*	3920	2710	2810	5490*	5630*
	SELENIUM	0.449	LT 0.449	LT 0.449	LT 0.449	LT 0.449	LT 0.449	LT 0.449	LT 0.449	LT 0.449	LT 0.449	LT 0.449	LT 0.449	LT 0.449	LT 0.449
	SODIUM	337	526*	573*	514*	592*	576*	573*	545*	571*	499*	482*	468*	629*	591*
	VANADIUM	28.39	28.8*	32.1*	33.8*	35.7*	35.1*	33*	32.9*	33.9*	28.3	30.7*	32.3*	34.6*	32.8*
	ZINC	102.8	67.1	84.7	89.5	95.7	81.5	85.1	81	87	77.1	55.6	58.3	88	87.8

Group	Analytes	Background Concentrations	SAS-95-03 (0.5ft)	SAS-95-04 (0.5ft)	SAS-95-05 (0.5ft)	SAS-95-06 (0.5ft)	SAS-95-07 (0.5ft)	SAS-95-08 (0.5ft)	SAS-95-09 (0.5ft)	SAS-95-10 (0.5ft)	SAS-95-10(D) (0.5ft)
METALS	ALUMINUM	28083	20500	28800*	15500	20000	23000	16400	16400	12800	16400
	ARSENIC	11.69	9.75	9.5	7.55	6.98	6.45	9.16	9.07	6.77	6.77
	BARIUM	247.1	225	365*	176	226	242	203	207	143	178
	BERYLLIUM	1.455	0.96	1.3	0.728	0.958	1.14	0.761	0.788	LT 0.427	0.732
	CADMIUM	0.847	1.43*	LT 1.2	LT 1.2	LT 1.2	1.42*	LT 1.2	LT 1.2	LT 1.2	LT 1.2
	CALCIUM	114483	40500	50200	31300	38500	34500	35200	42600	26000	32800
	CHROMIUM	20.62	25.1*	27.7*	20.5	24.7*	27.3*	20.6	20.5	18.3	22.4*
	COBALT	6.94	8.03*	10.1*	7.12*	8.39*	8.52*	6.98*	7.79*	5.49	6.26
	COPPER	24.72	20.9	22.4	19	22.8	23.9	18.3	17.4	14.5	17.6
	IRON	22731	22600	28000*	19700	22800*	26000*	20500	20300	16100	19900
	LEAD	18.23	23.2*	25.6*	30.3*	28.6*	25*	24.8*	23.1*	17.6	20.9*
	MAGNESIUM	7061	14000*	13300*	10900*	11700*	13400*	11100*	11500*	9410*	11600*
	MANGANESE	698.3	516	526	406	503	544	448	437	333	404
	MERCURY	0.0572	LT 0.05	LT 0.05	0.0574*	LT 0.05	0.0565	LT 0.05	0.0519	LT 0.05	LT 0.05
	NICKEL	17.4	18.2*	21.6*	15	21.5*	22.5*	16.7	17.6*	11.7	15.3
	POTASSIUM	5449	5390	4400	3680	4610	5710*	4230	3910	3310	4100
	SELENIUM	0.449	LT 0.449	LT 0.449	LT 0.449	LT 0.449	LT 0.449	LT 0.449	LT 0.449	LT 0.449	0.493*
	SODIUM	337	554*	2250*	547*	501*	495*	463*	497*	476*	563*
	VANADIUM	28.39	34.3*	37.3*	30.1*	34*	37.7*	29.3*	29.5*	27.3	33.5*
	ZINC	102.8	93.8	85.9	75.6	87	109*	80	74.2	58.5	73.9

Table 6-4. Summary of Analytes Detected in Soil for the Small Arms Firing Range (SWMU 8) - Phase II (continued)

Bullet Stops (Subsurface Soil)

Group	Analytes	Background Concentrations	SAB-94-01B (3ft)	SAB-94-02B (3ft)	SAB-94-03B (3ft)	SAB-94-04B (3ft)	SAB-94-05B (3ft)	SAB-94-06B (3ft)	SAB-94-07B (3ft)	SAB-94-08B (3ft)	SAB-94-09B (3ft)	SAB-94-10B (3ft)
METALS	ALUMINUM	28083	18100	15200	18800	18100	18900	19600	18900	20600	13000	17300
	ARSENIC	11.69	6.33	8.12	7.99	7.34	8.12	6.68	6.13	7.06	6.54	8.47
	BARIUM	247.1	172	199	229	211	189	252*	240	228	144	228
	BERYLLIUM	1.465	0.875	0.828	0.933	0.882	0.964	1.01	0.972	1.01	0.67	0.932
	CALCIUM	114483	53800	49900	55900	51100	54400	53900	46300	55100	38000	52700
	CHROMIUM	20.62	20.1	19	22.2*	21.8*	28.6*	22.1*	20.7*	23.5*	14.3	20.5
	COBALT	6.94	7.74*	6.75	7.45*	7.34*	8.62*	8.19*	7.96*	7.91*	5.27	8.02*
	COPPER	24.72	14.2	70.4*	20.3	18.1	14.7	16.9	15.1	19.1	11.5	17.8
	IRON	22731	21400	19500	21800	21000	25400*	23600*	22300	23100*	15500	21700
	LEAD	18.23	16.7	1500*	496*	45.1*	20.3*	22.9*	20.9*	127*	78.9*	23.1*
	MAGNESIUM	7061	13500*	11800*	13100*	12900*	14500*	13400*	13500*	12700*	8260*	12900*
	MANGANESE	698.3	439	393	379	420	422	461	379	394	267	471
	MERCURY	0.0572	0.0587*	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	0.0637*	LT 0.05
	NICKEL	17.4	15	16.6	17.8*	17.6*	20.1*	17.7*	17.1	18.2*	11.9	18.1*
	POTASSIUM	5449	2590	2730	3570	4290	2300	3450	2750	3820	2260	4070
	SODIUM	337	799*	439*	885*	683*	554*	968*	1110*	1150*	674*	1130*
	VANADIUM	28.39	31*	25	29.7*	27.2	41.4*	31.3*	28.7*	32*	18.4	26.3
	ZINC	102.8	60.9	71.3	71.1	77.3	71	77.5	68	76.5	50.9	82.5

Firing Lines (Subsurface Soil)

		Background Concentrations	SAB-94-11B (1ft)	SAB-94-12B (3ft)	SAB-94-13B (3ft)	SAB-94-14B (2ft)	SAB-94-15B (2ft)
METALS	ALUMINUM	28083	8400	15100	18300	21900	17700
	ARSENIC	11.69	5.52	7.11	9.87	6.03	6.37
	BARIUM	247.1	82.1	183	168	197	195
	BERYLLIUM	1.465	LT 0.427	0.875	0.902	0.944	1.07
	CALCIUM	114483	21400	42800	50800	40100	40800
	CHROMIUM	20.62	13.2	18.6	22.6*	40.2*	23.3*
	COBALT	6.94	4.56	7.69*	7.61*	8.06*	7.17*
	COPPER	24.72	9.21	13.5	14.5	17	15.9
	IRON	22731	13800	20700	22200	22900*	21100
	LEAD	18.23	12.3	15.9	15.7	18.6*	19.3*
	MAGNESIUM	7061	9040*	12100*	13000*	12200*	11400*
	MANGANESE	698.3	428	340	453	415	396
	NICKEL	17.4	11.6	17.4	16.2	23.2*	17.5*
	POTASSIUM	5449	1290	2250	2220	4290	3350
	SELENIUM	0.449	LT 0.449	LT 0.449	1.93*	LT 0.449	LT 0.449
	SODIUM	337	278	694*	781*	839*	793*
	VANADIUM	28.39	20.6	25.6	34.3*	36.9*	29.2*
	ZINC	102.8	40.5	67.4	55.8	75	71.6

Table 6-4. *Summary of Analytes Detected in Soil for the Small Arms Firing Range (SWMU 8) - Phase II (continued)*

Drainage Area (Subsurface Soil)

Group	Analytes	Background Concentrations	SAB-95-01B (2.3ft)	SAB-95-02B (2.1ft)	SAB-95-03B (3ft)	SAB-95-04B (3ft)	SAB-95-05B (1.5ft)	SAB-95-06B (1.5ft)	SAB-95-07B (2.3ft)	SAB-95-08B (3ft)	SAB-95-09B (3ft)	SAB-95-10B (3ft)	AB-95-10B(D) (2.4ft)
METALS	ALUMINUM	28083	5980	18500	22100	24700	19700	6830	14100	20200	17300	10900	11900
	ARSENIC	11.69	4.47	6.38	7.99	8.09	6.71	5	3.51	5.86	LT 2.5	5.33	6.02
	BARIUM	247.1	67	165	266*	241	228	64.4	162	231	234	144	152
	BERYLLIUM	1.455	LT 0.427	0.891	0.978	1.12	0.961	LT 0.427	0.616	0.966	0.735	LT 0.427	0.541
	CALCIUM	114483	26600	49100	53300	38000	48300	25200	33500	62000	39100	70000	32800
	CHROMIUM	20.62	9.12	20.1	24.9*	28.9*	23.5*	13	20.5	23.3*	18.2	18.3	20.6
	COBALT	6.94	2.89	6.64	8.47*	8.31*	8.2*	2.94	6.15	8.5*	6.57	5.42	7.02*
	COPPER	24.72	6.79	14	16.3	21.4	18.4	6.66	12.6	16.5	12.7	11.4	12.4
	IRON	22731	10000	23900*	23300*	25400*	22100	10700	18700	22600	17900	15600	16600
	LEAD	18.23	LT 7.44	26*	16.8	18.7*	24.6*	LT 7.44	15.7	18.5*	12.7	14.7	14.9
	MAGNESIUM	7061	6010	11900*	14000*	14500*	12600*	5550	9630*	13100*	10200*	9330*	8950*
	MANGANESE	698.3	141#	363	453	560	481	139#	380	381	271	298	301
	MERCURY	0.0572	LT 0.05	LT 0.05	LT 0.05	0.0611*	LT 0.05	LT 0.05	LT 0.05	0.0824*	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	7.66	17.8*	17.1	20.4*	20.3*	8.06	16	17.5*	13.3	12.5	12.8
	POTASSIUM	5449	1080#	3510	3240	6680*	4660	1320#	2540	3480	3250	2680	2820
	SODIUM	337	519*	672*	1590*	663*	501*	576*	1030*	1970*	1680*	463*	492*
	VANADIUM	28.39	15.7	32.7*	36.7*	40.4*	32.6*	19.7	24.4	34.9*	25.1	27.4	28.8*
	ZINC	102.8	27.9	75.4	71.8	101	84.8	28.7	52.5	76.4	56	58.2	55.4

Note.- All values in μg/g (equal to ppm).
LT = Analyte concentration is less than CRL , the CRL is posted next to the "LT".
* = Organic analyte detected above CRL or MDL or detected inorganic analyte exceeding background.
(D) = Duplicate analysis.

Surface- and subsurface-soil samples collected in the area beyond the bullet stop in November 1995 were found to contain metals that exceed background concentrations but at much lower levels than found in the bullet stop area. Figures 6-5 and 6-6 show the metals exceeding background concentrations in the area beyond the bullet stop. Cobalt (6.98 to 10.1 μg/g), chromium (21.5 to 28.9 μg/g), nickel (17.5 to 22.5 μg/g), lead (18.5 to 45.4 μg/g), and vanadium (28.8 to 40.4 μg/g) were the most frequently detected metals above background concentrations in both surface and subsurface soils throughout the area. No specific areas of concern or hot spots were identified beyond the bullet stop. In addition, review of surface versus subsurface data did not reveal any consistent trends in terms of increasing or decreasing concentrations with depth or distance from the bullet stop. The metals concentrations in this area also do not exceed corresponding risk-based concentrations. This indicates that metals contamination in the area beyond the bullet stop does not require further investigation.

6.1.3.3.1 ***Bullet Stop Sampling Locations.*** The presence of lead in concentrations almost three orders of magnitude above background confirms that this metal is present as a direct result of firing activity at this site. Lead concentrations exceeded background in surface soil samples collected 0.5 feet bgs at four of the five boring locations (SAB-94-02 through SAB-94-05) and at one surface soil sampling location (SAS-94-01) across the back of the bullet stop, ranging from 545 (SAB-95-05A) to 33,000 μg/g (SAB-94-02A) (Figure 6-7). As shown in Figure 6-8, soils collected 3 feet bgs at the boring locations contained lower lead concentrations. Along the back bullet stop, subsurface lead concentrations ranged from 20.3 to 1,500 μg/g (SAB-94-02B). The two surface soil samples collected along the slope between the back bullet stop and the front bullet stop (SAS-94-02 and SAS-94-03) were found to contain lead concentrations at 102 μg/g and 39.1 μg/g, respectively (see Figure 6-7).

Along the front bullet stop, lead concentrations in surface soil samples were collected 0.5 feet bgs at the boring locations SAB-94-06 through SAB-94-10 and at surface soil locations SAS-94-04 through SAS-94-08, ranging from 51.3 μg/g (SAS-94-08) to 26,000 μg/g (SAB-94-08A). As with the samples collected at the back bullet stop, the concentrations were much lower in the soil collected at 3 feet bgs, where lead was present at a maximum concentration of 127 μg/g (SAB-94-08B). In both the back and front bullet stops, the boring locations containing the highest lead concentrations at 0.5 feet also contained the highest lead concentration in the samples collected at 3 feet bgs (Figure 6-7 and 6-8).

Copper was also present in soils collected from the bullet stop areas at concentrations above the background concentration of 24.7 μg/g. Figure 6-7 shows the distribution of copper in samples collected 0.5 foot bgs across the site. The copper concentration range detected in soils collected 0.5 feet bgs along the back bullet stop was from below background to 1,700 μg/g (SAB-94-02A). The front bullet stop soils collected at this same depth had a concentration range from below background to 879 μg/g (SAB-94-08A). In the samples collected from 3 feet bgs at the boring locations at both the front and back bullet stops, copper was detected above background in only one sample (70.4 μg/g in SAB-94-02B). These elevated concentrations, when compared to the background concentration, suggest some copper contamination resulting from activity at the site.

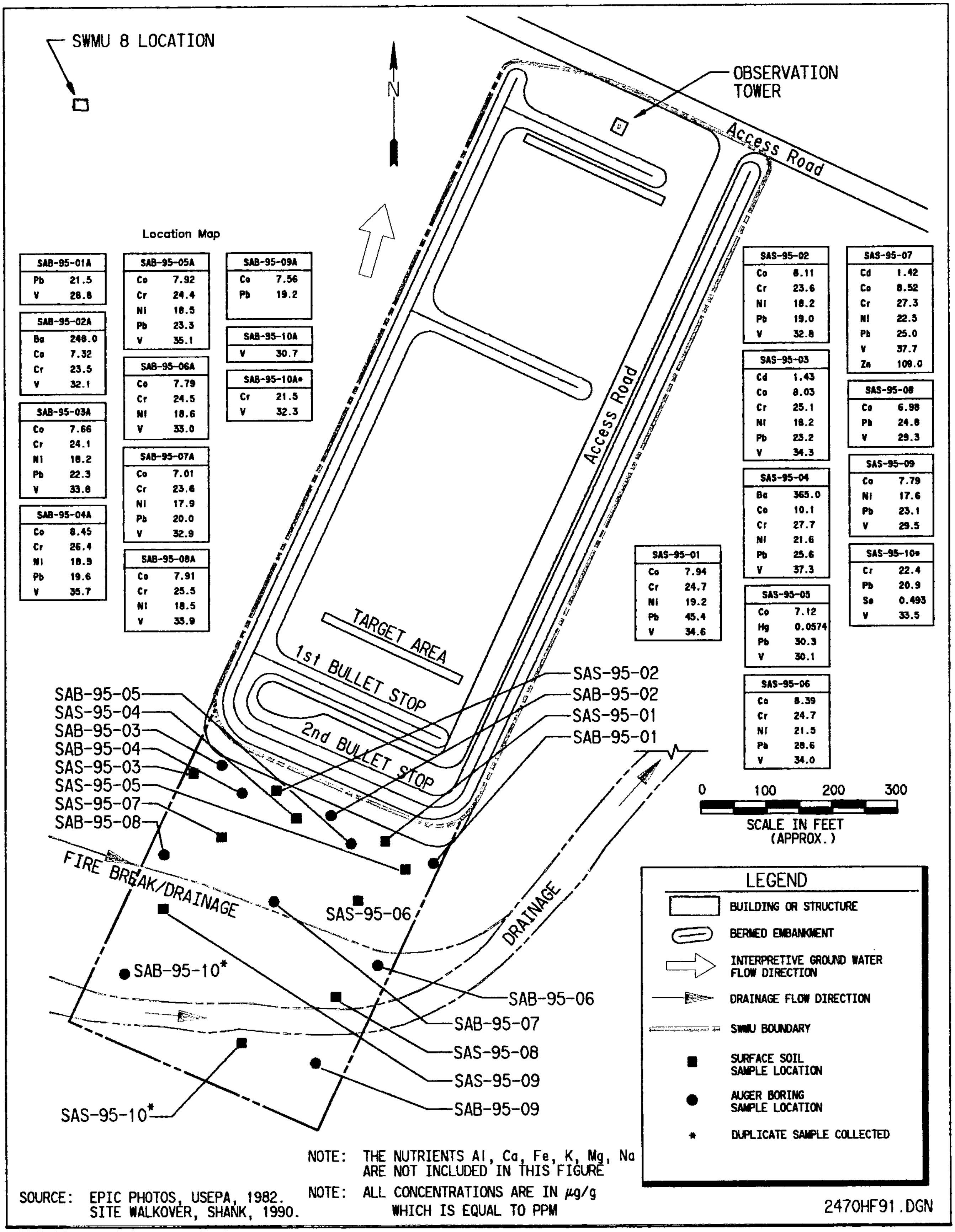

Figure 6-5. SWMU 8 Phase II Surface Soil Results for Area Beyond Bullet Stop

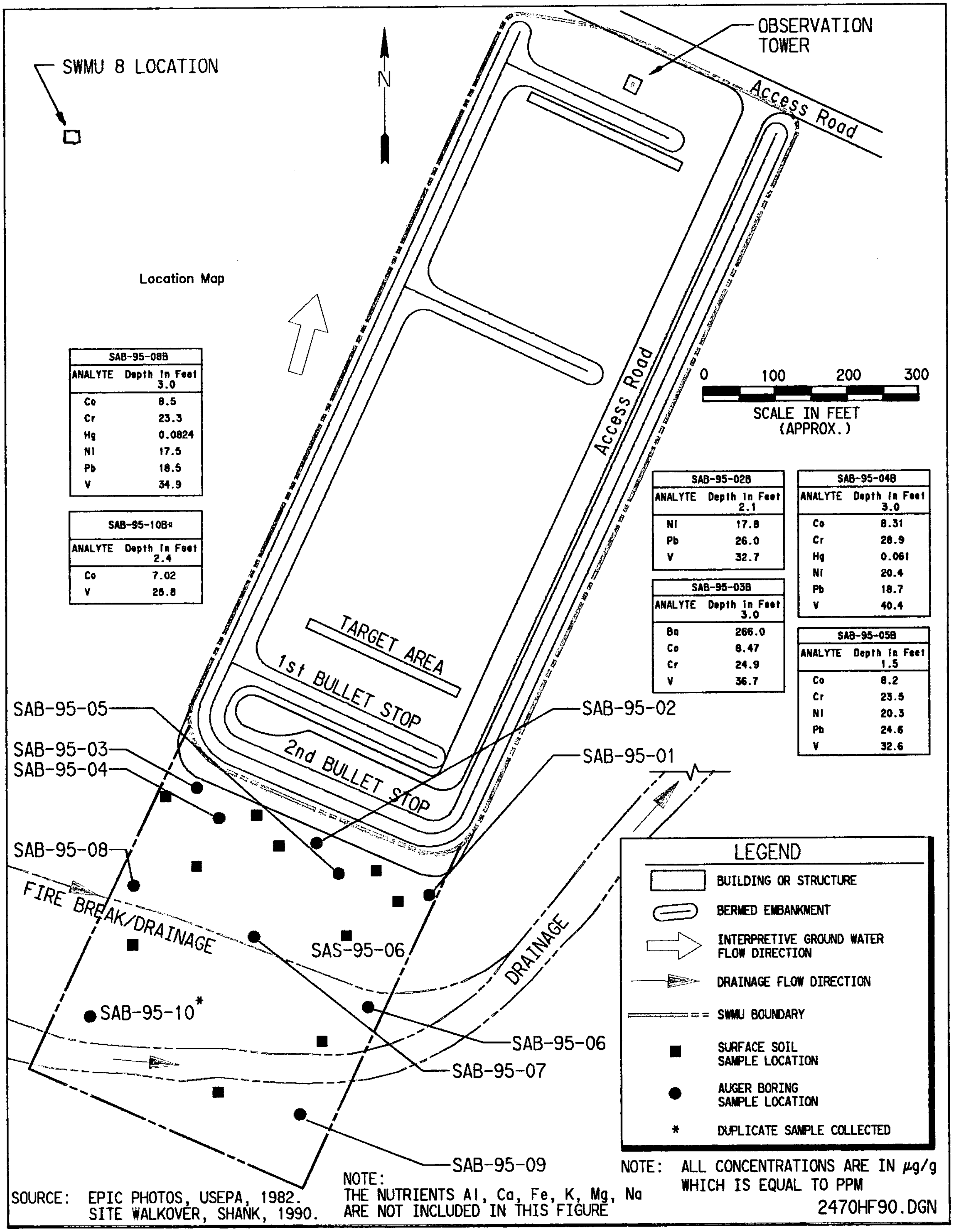

Figure 6-6. SWMU 8 Phase II Subsurface Soil Results for Area Beyond Bullet Stop

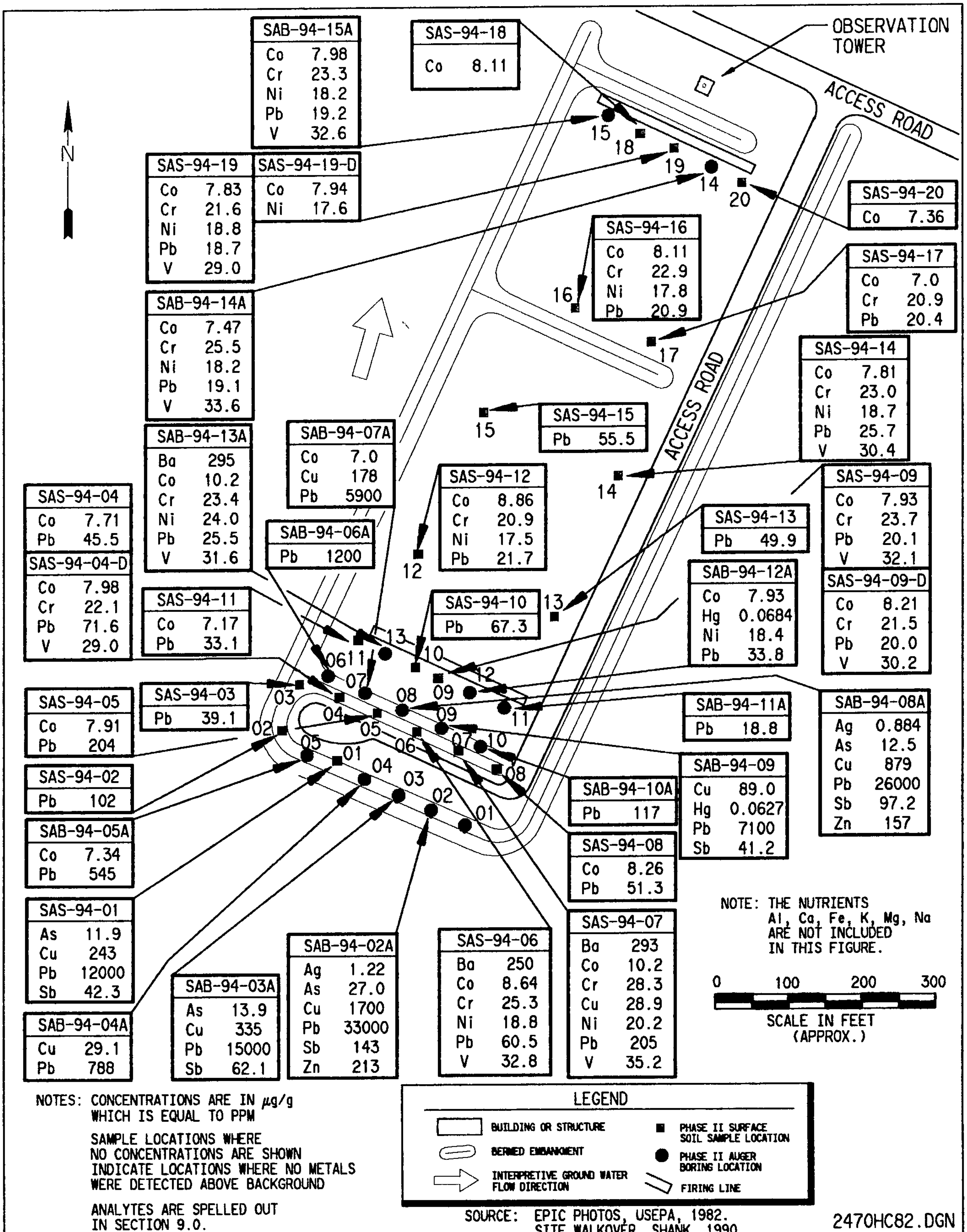

Figure 6-7. SWMU 8 Phase II Surface Soil Results for Area Beyond Bullet Stop

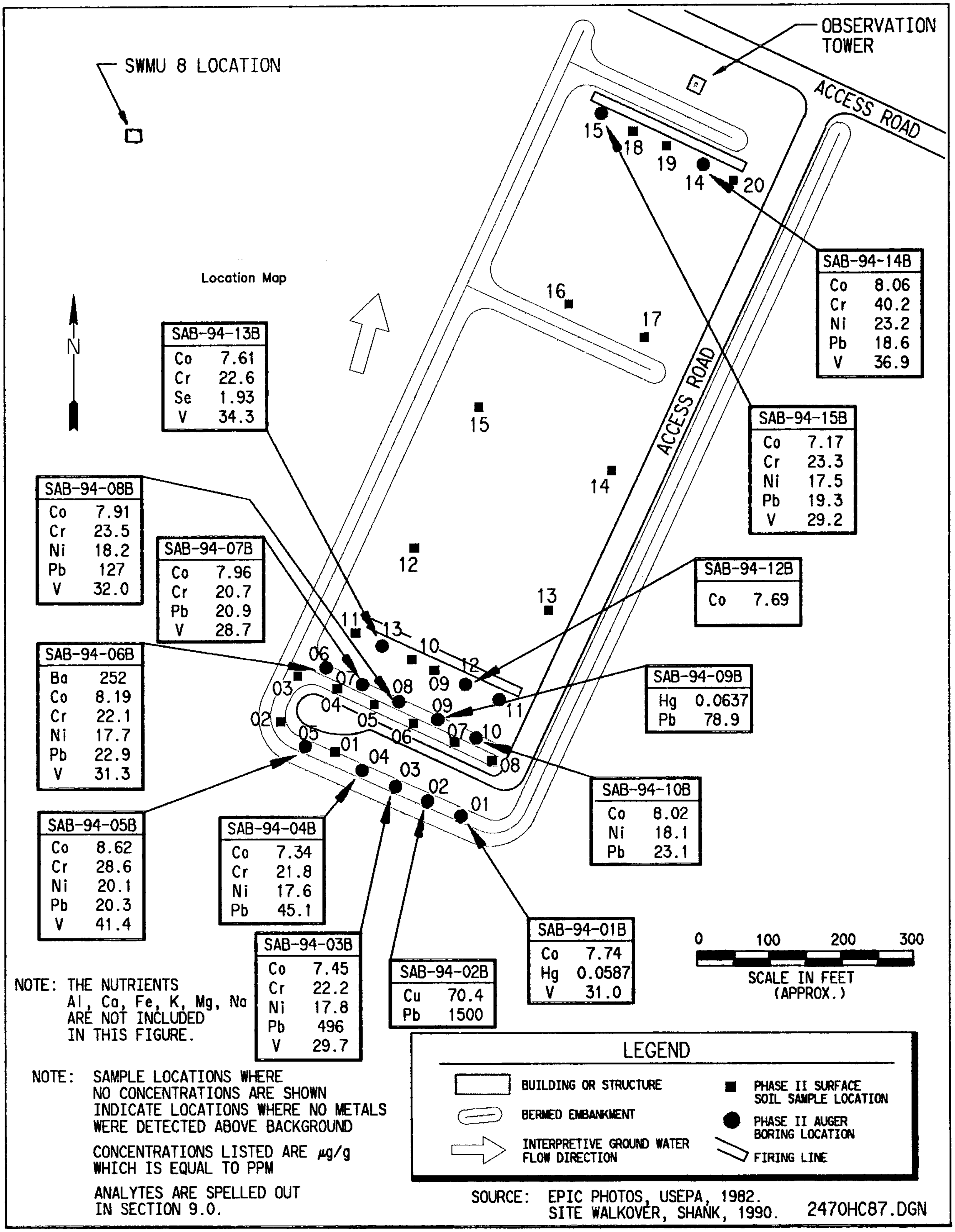

Figure 6-8. SWMU 8 Phase II Subsurface Soil Results

Cobalt, the most prevalent metal other than lead, was present in 22 samples at concentrations above the background value of 6.94 $\mu g/g$ with the maximum of 10.2 $\mu g/g$ detected in samples SAS-94-07 and SAB-94-13A (Figure 6-7). As the data show, detected cobalt concentrations are all less than twice the background concentration.

The distribution of chromium is presented in Figures 6-7 and 6-8. Chromium was present above background concentrations in 13 samples, ranging from 20.7 to 28.6 $\mu g/g$ (SAB-94-05B). Nickel (Figures 6-7 and 6-8), which has a background concentration of 17.4 $\mu g/g$, was present in concentrations above background in 11 samples, ranging from 17.4 $\mu g/g$ to 20.2 $\mu g/g$ (SAS-94-07). Figures 6-7 and 6-8 show the distribution of vanadium in both the surface and subsurface soil collected 3 feet bgs, respectively. Vanadium was present above a background concentration of 28.4 $\mu g/g$ in 13 samples, ranging from 28.7 $\mu g/g$ to 41.4 $\mu g/g$ (SAB-94-05B).

Figure 6-7 shows the locations in which the surface soils contained above background concentrations of other metals such as mercury, antimony, barium, silver, zinc, and arsenic. Likewise, Figure 6-8 shows the data for soils collected 3 feet bgs and, specifically, the concentrations of mercury, copper, barium, and selenium, all of which exceeded background.

Mercury was present above the background concentration (0.0572 $\mu g/g$) in only four samples, ranging from 0.0587 $\mu g/g$ to 0.0637 $\mu g/g$ (SAB-94-09B). Antimony was detected above its respective background concentration of 15 $\mu g/g$ in five samples, ranging from 41.2 $\mu g/g$ to 143 $\mu g/g$ in soil sample SAB-94-02A.

Other metals were also detected above background concentrations. Barium was present in four soil samples with a maximum concentration of 295 $\mu g/g$ from the sample collected from SAB-94-13A (background concentration of barium is 247.1 $\mu g/g$). Silver was above background (0.66 $\mu g/g$) in only two samples, with a maximum concentration of 1.22 $\mu g/g$ present in the soil collected from SAB-94-02A. Zinc was also detected above background (102.8 $\mu g/g$) in only two samples at a maximum concentration of 213 $\mu g/g$ (SAB-94-02A). Arsenic was detected in four samples at concentrations ranging from 11.9 $\mu g/g$ to 27 $\mu g/g$ (SAB-94-02A) compared to the background concentration of 11.7 $\mu g/g$.

6.1.3.3.2 ***Firing Line Sample Locations.*** As previously mentioned, metal contaminant concentrations were lower in samples collected from the firing line locations than those associated with the bullet stop. In most instances, the detected concentrations were comparable to the background concentrations. Soil samples collected from the firing line locations contained lead, chromium, cobalt, nickel, vanadium, mercury, barium, and selenium in concentrations above their respective background concentrations. Copper, silver, arsenic, antimony, and zinc were detected above background concentrations in the bullet stop samples but were not present above background in the firing line samples.

Lead was detected above its background at concentrations ranging from 18.8 μg/g to 67.3 μg/g (SAS-94-10). Chromium was also detected above background at concentrations ranging from 21.5 μg/g to 40.2 μg/g (SAB-94-14B). As with the soil samples collected at the bullet stop, soil collected at the firing line locations contained cobalt in concentrations slightly above the background concentration. Cobalt concentrations ranged from 7.17 μg/g to a maximum of 10.2 μg/g (SAB-94-13A). Nickel was detected at concentrations ranging from 17.4 μg/g to 24 μg/g (SAB-94-13A). Vanadium was detected at concentrations ranging from 29.0 μg/g to 36.9 μg/g (SAB-94-14B). Mercury, barium, and selenium were present in concentrations of 0.068 μg/g, 295 μg/g, and 1.93 μg/g, respectively. Selenium was the only metal present at the firing line that was not detected in the bullet stop areas.

6.1.3.3.3 ***Surface Between Firing Lines.*** This area contains six surface soil sampling locations (SAS-94-12 through SAS-94-17). Lead, chromium, cobalt, nickel, and vanadium were all present above their respective background concentrations. Although lead was present in above background concentrations, the levels were well below those encountered in the soil samples associated with the two bullet stops. The maximum lead concentration detected was 55.5 μg/g (SAS-94-15). Both chromium and cobalt were present in four of the six samples, with maximum concentrations of 23 μg/g and 8.86 μg/g, respectively. These maximum concentrations are similar to those encountered in samples collected from both the bullet stops and the firing lines. The nickel distribution is similar to chromium and cobalt, since it was widespread throughout this area of the site (above background in three of the six sample locations) and in concentrations similar to those found in the vicinity of the bullet stops and the firing lines. The maximum nickel concentration was 18.7 μg/g (SAS-94-14). The final metal, vanadium, was present in only one soil sample above background concentrations, with a maximum concentration of 30.4 μg/g.

6.1.3.3.4 ***Sieved Versus Unsieved Samples.*** From the analytical data associated with the soil samples collected from the borings at depths of 0.5 and 3.0 feet, the general trend appears to be higher lead concentrations in the shallow samples compared to the deeper samples. In addition, the surface soil samples collected at other locations also contained higher lead concentrations compared to the deeper soil samples collected from the same borings. The effect of sieving the samples in an attempt to correlate lead concentrations with grain size appears to be inconclusive. It was originally suspected that the analytical results from Phase I sampling, which show one sample containing 40,000 μg/g lead, were from bullet fragments being incorporated in the sample material. It is assumed that much of the lead was contained in the bullet fragments in a form resistant to leaching, and sieving out the coarse fraction would reduce the amount of lead in the sample.

Sieving of soil samples collected from the borings at 0.5 feet bgs had the overall effect of increasing the lead concentrations rather than reducing them as suspected since the highest concentrations were present in samples that were sieved. This may indicate that much of the lead detected has been leached from the fragments and subsequently adsorbed in the silt and clay particles. As shown in Figure 6-7, which shows the results of soils collected from the

borings, the sieved shallow samples had lead concentrations that ranged from below background (18.2 $\mu g/g$) to 33,000 $\mu g/g$, while the unsieved samples ranged from below background to 15,000 $\mu g/g$. The same effect of sieving from the samples collected 3 feet bgs was observed, with the sieved samples having higher lead concentration ranges compared to the unsieved samples (background to 1,500 $\mu g/g$ and background to 496 $\mu g/g$, respectively).

The analytical data from surface soil locations suggest that sieving reduced lead concentrations. The unsieved samples contained lead concentrations ranging from background to 12,000 $\mu g/g$, while the sieved samples ranged from background to 102 $\mu g/g$. This may indicate that surface lead debris is responsible for surface contamination, whereas leaching of surface contaminants and subsequent adsorption by silts and clays in subsurface soils are responsible for subsurface contamination.

In summary, the fact that this sieving method reduced lead in only part of the samples demonstrates that this is not a reliable technique for determining the distribution of lead in soils collected at the Small Arms Firing Range. However, physical separation is still likely to be the most effective initial method for reducing the primary lead contaminants. Additional treatment of the fine fraction, however, would still be required for any future remediation at the site. Available alternatives will be evaluated as part of the FS.

6.1.3.3.5 ***Drainage Area Behind Bullet Stops.*** As shown in Figures 6-5 and 6-6, aluminum, barium, chromium, cobalt, iron, lead, magnesium, mercury, nickel, potassium, selenium, sodium, vanadium, and zinc exceeded background in at least one sample. However, nearly all of the detections were just above background and no hot spots or areas of concern were identified.

6.1.3.3.6 ***Summary.*** Various metals were detected at concentrations exceeding background values from the samples collected at the Small Arms Firing Range. The highest concentrations and frequency of detections for these metals were in the near surface soils associated with the bullet stop areas. Metals detected at concentrations that only slightly exceeded background values were scattered throughout the SWMU.

6.1.4 Human Health Risk Assessment

As part of the Phase II RI, an RA was conducted to estimate potential human health risks associated with the no-action alternative for SWMU 8, the Small Arms Firing Range. The following tasks were completed in the RA:

- Data analysis and selection of COPCs
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Conclusions and recommendations

This section provides a summary of the quantitative process employed at SWMU 8 and the results of that process. The RA for SWMU 8 is based on the methodology described in Section 3.1 and supported by Appendices L, M, N, and O.

6.1.4.1 *Selection of the Chemicals of Potential Concern for Soils*

As detailed in Region VIII guidance, a screening procedure can be used to narrow the list of contaminants at a particular site to a subset of analytes that can be considered the COPCs for the area. This screening procedure can involve up to four steps, depending on the contaminants present:

- Group data by chemical class (e.g., carcinogenic PAHs)
- Evaluate frequency of detection
- Evaluate essential nutrients
- Compare site data to risk-based screening concentrations (Region III values)

Below is the screening analysis for SWMU 8.

6.1.4.1.1 ***Data Grouping.*** No data grouping was necessary as part of COPC selection at SWMU 8.

6.1.4.1.2 ***Frequency of Detection.*** No analytes were detected in fewer than 5 percent of samples within an area of concern.

6.1.4.1.3 ***Nutrient Screening***

Bullet Stops. All of the nutrients detected above background in surface soil had maximum detected values that were less than their respective nutrient screening values: iron (maximum—26,900 μg/g; screening value—70,000 μg/g), magnesium (maximum—13,600 μg/g; screening value—1,000,000 μg/g), and sodium (maximum—1,090 μg/g; screening value—1,000,000 μg/g). Therefore, these nutrients were eliminated as COPCs in surface soil.

Similarly, all of the nutrients detected above background in subsurface soil had maximum detected values that were less than their respective nutrient screening values: iron (maximum—25,400 μg/g; screening value—70,000 μg/g), magnesium (maximum—14,500 μg/g; screening value—1,000,000 μg/g), and sodium (maximum—1,150 μg/g; screening value—1,000,000 μg/g). Therefore, these nutrients were eliminated as COPCs in subsurface soil.

Firing Lines. All of the nutrients detected above background in surface soil had maximum detected values that were less than their respective nutrient screening values: iron (maximum—

27,400 μg/g; screening value—70,000 μg/g), magnesium (maximum—13,600 μg/g; screening value—1,000,000 μg/g), and sodium (maximum—513 μg/g; screening value—1,000,000 μg/g). These nutrients were therefore eliminated as COPCs in surface soil.

All of the nutrients detected above background in subsurface soil also had maximum detected values that were less than their respective nutrient screening values: iron (maximum—22,900 μg/g; screening value—70,000 μg/g), magnesium (maximum—13,000 μg/g; screening value—1,000,000 μg/g), and sodium (maximum—839 μg/g; screening value—1,000,000 μg/g). Therefore, these nutrients were eliminated as COPCs in subsurface soil.

Area Between the Firing Lines. Magnesium was the only nutrient metal detected above background in surface soil in the area between the firing lines. The maximum concentration of magnesium (13,700 μg/g) was less than the screening value (1,000,000 μg/g). Therefore, magnesium was eliminated as a COPC in surface soil for this area of concern.

Drainage Area. All of the nutrients detected above background in surface soil had maximum detected values that were less than their respective nutrient screening values: iron (maximum—28,000 μg/g; screening value—70,000 μg/g), magnesium (maximum—14,100 μg/g; screening value—1,000,000 μg/g), potassium (maximum—6,260 μg/g; screening value—150,000 μg/g), and sodium (maximum—2,250 μg/g; screening value—1,000,000 μg/g). Therefore, these nutrients were eliminated as COPCs in surface soil.

All of the nutrients detected above background in subsurface soil also had maximum detected values that were less than their respective nutrient screening values: iron (maximum—25,400 μg/g; screening value—70,000 μg/g), magnesium (maximum—14,500 μg/g; screening value—1,000,000 μg/g), potassium (maximum—6,680 μg/g; screening value—150,000 μg/g), and sodium (maximum —1,970 μg/g; screening value—1,000,000 μg/g). Therefore, these nutrients were eliminated as COPCs in subsurface soil.

6.1.4.1.4 ***Region III RBC Screening.*** The final step in the COPC selection process consisted of comparing the EPCs for remaining contaminants in surface and subsurface soil with Region III RBCs. However, before these comparisons were made, a "hot spot" analysis was conducted.

Hot Spot Analysis. Within each sampling area (the bullet stops, the firing lines, the area between the firing lines, and the drainage area), the distribution of contaminant concentrations appeared to be fairly uniform (i.e., there were no distinct hot spots with respect to a 0.5-acre lot). Therefore, each sampling area was evaluated in its entirety as an area of concern, using all samples collected from each area to determine EPCs.

Table 6-5 provides a summary of the EPCs for preliminary COPCs in surface and subsurface soil at SWMU 8. To select COPCs for soils, the EPCs for each area of concern at the SWMU in surface and subsurface soil were compared to Region III soil ingestion and soil-to-air RBCs.

Table 6-5. Summary of Preliminary Chemicals of Potential Concern (SWMU 8)

Chemical	Frequency of Detection[a]	Range of Detected Values (μg/g)[b]	Range of Reporting Limits (μg/g)	Arithmetic Mean Concentration (μg/g)	95% UCL[c] Concentration (μg/g)	Exposure Point Concentration[d] (μg/g)
Bullet Stops - Surface Soil						
Antimony	5/22	41.2 - 143	19.6	21.8	35.2	35.2
Arsenic	22/22	5.72 - 27.0	NA[e]	8.85	10.3	10.3
Barium	22/22	62.1 - 293	NA	166	188	188
Boron	4/4	9.79 - 19.3	NA	12.6	22.6	19.3
Chromium	22/22	6.27 - 28.3	NA	16.5	19.5	19.5
Cobalt	21/22	3.34 - 10.2	2.5	6.0	6.8	6.8
Copper	22/22	9.25 - 1,700	NA	108	375	375
Lead	22/22	12.9 - 33,000	NA	5,756	124,249	33,000
Mercury	3/22	0.052 - 0.063	0.05	0.029	0.033	0.033
Nickel	22/22	7.04 - 20.2	NA	13.6	15.0	15.0
Silver	2/22	0.884 - 1.22	0.803	0.46	0.51	0.51
Vanadium	20/22	10.9 - 35.2	1.86 - 2.71	21.4	24.6	24.6
Zinc	22/22	19.7 - 213	NA	70.4	90.8	90.8
Bullet Stops - Subsurface Soil						
Barium	10/10	144 - 252	NA	208	234	234
Chromium	10/10	14.3 - 28.6	NA	21.4	23.8	23.8
Cobalt	10/10	5.27 - 8.62	NA	7.53	8.10	8.10
Copper	10/10	11.5 - 70.4	NA	20.9	30.5	30.5
Lead	10/10	16.7 - 1,500	NA	172	2,043	1,500
Mercury	2/10	0.059 - 0.064	0.05	0.032	0.042	0.042
Nickel	10/10	11.9 - 20.1	NA	17.0	18.3	18.3
Vanadium	10/10	18.4 - 41.4	NA	29.1	33.5	33.5
Firing Lines - Surface Soil						
Barium	11/11	156 - 295	NA	203	226	226
Chromium	11/11	15.4 - 25.5	NA	20.9	22.8	22.8
Cobalt	11/11	5.62 - 10.2	NA	7.70	8.40	8.40
Lead	11/11	17.0 - 67.3	NA	26.0	35.0	35.0
Mercury	1/11	0.068	0.05	0.029	0.035	0.035

Table 6-5. Summary of Preliminary Chemicals of Potential Concern (SWMU 8) (continued)

Chemical	Frequency of Detection[a]	Range of Detected Values (μg/g)[b]	Range of Reporting Limits (μg/g)	Arithmetic Mean Concentration (μg/g)	95% UCL[c] Concentration (μg/g)	Exposure Point Concentration[d] (μg/g)
Firing Lines - Surface Soil (continued)						
Nickel	11/11	13.0 - 24.0	NA	17.4	19.1	19.1
Vanadium	11/11	21.1 - 33.6	NA	27.5	30.4	30.4
Firing Lines - Subsurface Soil						
Chromium	5/5	13.2 - 40.2	NA	23.5	43.5	40.2
Cobalt	5/5	4.56 - 8.06	NA	7.05	9.36	8.06
Lead	5/5	12.3 - 19.3	NA	16.4	20.0	19.3
Nickel	5/5	11.6 - 23.2	NA	17.2	23.3	23.2
Selenium	1/5	1.93	0.449	0.489	5.81	1.93
Vanadium	5/5	20.6 - 36.9	NA	29.4	39.1	36.9
Between Firing Lines - Surface Soil						
Chromium	6/6	14.8 - 23.0	NA	19.8	23.6	23.0
Cobalt	6/6	6.32 - 8.86	NA	7.41	8.43	8.43
Lead	6/6	20.4 - 55.5	NA	32.0	56.1	55.5
Nickel	6/6	13.7 - 18.7	NA	15.9	18.3	18.3
Vanadium	6/6	21.3 - 30.4	NA	26.1	29.4	29.4
Drainage Area - Surface Soil						
Aluminum	20/20	12,400 - 28,800	NA	19,070	20,623	20,623
Barium	20/20	147 - 365	NA	218	236	236
Cadmium	2/20	1.42 - 1.43	1.2	0.68	0.76	0.76
Chromium	20/20	19.5 - 27.7	NA	23.6	24.5	24.5
Cobalt	20/20	5.35 - 10.1	NA	7.63	8.06	8.06
Lead	20/20	16.4 - 45.4	NA	23.0	25.4	25.4
Nickel	20/20	12.6 - 22.5	NA	17.9	19.0	19.0
Selenium	1/20	0.493	0.449	0.238	0.255	0.255
Vanadium	20/20	28.3 - 37.7	NA	32.9	34.0	34.0
Zinc	20/20	58.3 - 109	NA	83.2	87.8	87.8

Table 6-5. Summary of Preliminary Chemicals of Potential Concern (SWMU 8) (continued)

Chemical	Frequency of Detection[a]	Range of Detected Values (μg/g)[b]	Range of Reporting Limits (μg/g)	Arithmetic Mean Concentration (μg/g)	95% UCL[c] Concentration (μg/g)	Exposure Point Concentration[d] (μg/g)
Drainage Area - Subsurface Soil						
Barium	10/10	64.4 - 266	NA	181	223	223
Chromium	10/10	9.12 - 28.9	NA	20.4	25.9	25.9
Cobalt	10/10	2.89 - 8.50	NA	6.61	9.09	8.50
Lead	8/10	12.7 - 26.0	7.44	15.5	19.9	19.9
Mercury	2/10	0.061 - 0.082	0.05	0.034	0.047	0.047
Nickel	10/10	7.66 - 20.4	NA	15.2	19.5	19.5
Vanadium	10/10	15.7 - 40.4	NA	29.1	35.6	35.6

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]Micrograms per gram.
[c]Upper control limit.
[d]The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (USEPA 1989).
[e]Not applicable.

Bullet Stops. As shown in Table 6-6, four analytes were retained as COPCs in bullet stop surface soils: antimony, arsenic, copper, and lead. Only lead was retained as a COPC in subsurface soil.

Firing Lines. No analytes were retained as COPCs in surface soil at the firing lines. Chromium was the only COPC retained for subsurface soil.

Area Between the Firing Lines. No chemicals were retained as COPCs for surface soil in the area between the firing lines.

Drainage Area. In the drainage area, aluminum is the only analyte retained as a COPC for surface soil. No chemicals were retained as COPCs for subsurface soil.

6.1.4.1.5 *Site-Wide Soils.* Concentrations of the COPCs for surface soils—aluminum, antimony, arsenic, copper, and lead—were calculated on a site-wide basis for the purpose of evaluating site-wide exposure scenarios. Site-wide concentrations were calculated utilizing all 59 surface soil samples collected at SWMU 8. The site-wide concentrations of these surface soil COPCs are provided in Table 6-7.

6.1.4.2 ***Selection of Chemicals of Potential Concern for Groundwater.***

The selection of COPCs for the groundwater exposure pathways consist of a two-phase modeling approach. Initially, the *maximum* concentration of each analyte detected in either surface or subsurface soil was compared to the Region III soil-to-groundwater RBC. One-tenth of the value was used for noncarcinogens. If the maximum concentration of a chemical exceeded the soil-to-groundwater RBC, the chemical was selected for vadose zone modeling (Table 6-8). The modeled break-through concentration in groundwater for these chemicals was then compared to the Region III tap water RBCs, with one-tenth of the value used for noncarcinogens. In addition, the modeled break-through time was compared to the 100-year cut-off period as described in Section 2.7.2. A chemical that reached the water table within 100 years *and* had a modeled break-through concentration that exceeded the Region III tap water RBC (one-tenth of the value for noncarcinogens) was retained for further vadose-saturated zone modeling to on- and off-site hypothetical receptors as described in Section 2.7.2. For this second phase of modeling, the *average* surface and subsurface soil concentration was used to calculate the initial pore water concentration at the site. Again, the vadose-saturated zone modeling results were compared to the Region III tap water RBCs, with one-tenth for noncarcinogens. If the chemical still failed to meet the 100-year break-through criteria *and* exceeded the Region III tap water RBC, it was retained for quantitative risk assessment. As shown in Table 6-8, aluminum, antimony, arsenic, barium, boron, cadmium, chromium, copper, lead, nickel, selenium, and vanadium were retained for vadose zone modeling.

Table 6-6. Selection of Chemicals of Potential Concern for Soil-related Pathways Based on EPA Region III's RBCs (SWMU 8)

	EPA[a] Region III RBC[b] Screen			
	Residential RBCs (μg/g)[c]			
Chemical	**Ingestion**	**Inhalation**	**Exposure Point Conc. (μg/g)**	**Retained as COPC[d]?**
Bullet Stops - Surface Soil				
Antimony	3.1	NA[e]	35.2	YES
Arsenic	0.43	380	10.3	YES
Barium	550	35,000	188	No
Boron	700	NA	19.3	No
Chromium	39.0	140	19.5	No
Cobalt	470	NA	6.8	No
Copper	310	NA	375	YES
Lead	400[f]	NA	33,000	YES
Mercury	2.3	0.7	0.033	No
Nickel	160	6,900	15.0	No
Silver	39.0	NA	0.51	No
Vanadium	55.0	NA	24.6	No
Zinc	2,300	NA	90.8	No
Bullet Stops - Subsurface Soil				
Barium	550	35,000	234	No
Chromium	39.0	140	23.8	No
Cobalt	470	NA	8.10	No
Copper	310	NA	30.5	No
Lead	400[f]	NA	1,500	YES
Mercury	2.3	0.7	0.042	No
Nickel	160	6,900	18.3	No
Vanadium	55.0	NA	33.5	No
Firing Lines - Surface Soil				
Barium	550	35,000	226	No
Chromium	39.0	140	22.8	No
Cobalt	470	NA	8.40	No
Lead	400[f]	NA	35.0	No
Mercury	2.3	0.7	0.035	No
Nickel	160	6,900	19.1	No
Vanadium	55.0	NA	30.4	No
Firing Lines - Subsurface Soil				
Chromium	39.0	140	40.2	YES
Cobalt	470	NA	8.06	No
Lead	400[f]	NA	19.3	No
Nickel	160	6,900	23.2	No
Selenium	39.0	NA	1.93	No
Vanadium	55.0	NA	36.9	No

Table 6-6. Selection of Chemicals of Potential Concern for Soil-related Pathways Based on EPA Region III's RBCs (SWMU 8) (continued)

	EPA[a] Region III RBC[b] Screen			
	Residential RBCs (μg/g)[c]			
Chemical	Ingestion	Inhalation	Exposure Point Conc. (μg/g)	Retained as COPC[d]?
Between Firing Lines - Surface Soil				
Chromium	39.0	140	23.0	No
Cobalt	470	NA	8.43	No
Lead	400[f]	NA	55.5	No
Nickel	160	6,900	18.3	No
Vanadium	55.0	NA	29.4	No
Drainage Area - Surface Soil				
Aluminum	7,800	NA	20,623	YES
Barium	550	35,000	236	No
Cadmium	3.9	920	0.76	No
Chromium	39.0	140	24.5	No
Cobalt	470	NA	8.06	No
Lead	400[f]	NA	25.4	No
Nickel	160	6,900	19.0	No
Selenium	39.0	NA	0.255	No
Vanadium	55.0	NA	34.0	No
Zinc	2,300	NA	87.8	No
Drainage Area - Subsurface Soil				
Barium	550	35,000	223	No
Chromium	39.0	140	25.9	No
Cobalt	470	NA	8.50	No
Lead	400[f]	NA	19.9	No
Mercury	2.3	0.7	0.047	No
Nickel	160	6,900	19.5	No
Vanadium	55.0	NA	35.6	No

Note.—RBCs were taken directly from the Region III RBC Table (USEPA 1995), except as noted in the footnotes. Values for noncarcinogens are 1/10 of the Region III RBC.

[a]U.S. Environmental Protection Agency.
[b]Risk-based calculations.
[c]Micrograms per gram.
[d]Chemicals of potential concern.
[e]Not applicable; value could not be calculated.
[f]OSWER recommended clean-up level for lead in residential soil (USEPA 1994).

Table 6-7. Site-Wide Surface Soil Exposure Point Concentrations of Chemicals of Potential Concern (SWMU 8)

Chemical	Frequency of Detection[a]	Range of Detected Values (μg/g)[b]	Range of Reporting Limits (μg/g)	Arithmetic Mean Concentration (μg/g)	95% UCL[c] Concentration (μg/g)	Exposure Point Concentration[d] (μg/g)
Aluminum	59/59	4,400 - 28,800	NA[e]	16,381	17,438	17,438
Antimony	5/59	41.2 - 143	1.0 - 19.6	15.3	31.5	31.5
Arsenic	59/59	5.37 - 27.0	NA	8.17	8.70	8.70
Copper	59/59	9.25 - 1,700	NA	38.4	52.3	52.3
Lead	59/59	12.9 - 33,000	NA	537	1,596	1,596

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]Micrograms per gram.
[c]Upper control limit.
[d]The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (USEPA 1989).
[e]Not applicable.

Table 6-8. *Selection of COPCs for Groundwater Exposure Pathways (SWMU 8)*

Chemical	Maximum Above Background (μg/g)[a]	Depth	Soil-to-GW RBC[b] (μg/g)	Selected for Vadose Zone Modeling?	Reached the Water Table Within 100 Years	Model Output: Break-Through Point Concentration in Ground Water (mg/L)[c]	Tap Water RBC (mg/L)	Selected as COPC[d] for Ground Water[e]?
Aluminum	28,800	Surface	590[f]	**YES**	No	NA[g]	NA	No
Antimony	143	Surface	0.27	**YES**	No	NA	NA	No
Arsenic	27	Surface	15	**YES**	No	NA	NA	No
Barium	365	Surface	3.2	**YES**	No	NA	NA	No
Boron	19.3	Surface	10.5	**YES**	No	NA	NA	No
Cadmium	1.43	Surface	0.6	**YES**	No	NA	NA	No
Chromium	40.2	Surface	1.9	**YES**	No	NA	NA	No
Cobalt	10.2	Surface	119[f]	No	No	NA	NA	No
Copper	1,700	Surface	31[f]	**YES**	No	NA	NA	No
Lead	33,000	Surface	15	**YES**	No	NA	NA	No
Mercury	0.0824	Subsurface	0.3[f]	No	No	NA	NA	No
Nickel	24	Surface	2.1	**YES**	No	NA	NA	No
Selenium	1.93	Subsurface	0.3	**YES**	No	NA	NA	No
Silver	1.22	Surface	19[f]	No	No	NA	NA	No
Vanadium	41.4	Subsurface	5.2[f]	**YES**	No	NA	NA	No
Zinc	213	Surface	4,200	No	No	NA	NA	No

Note.—RBCs were taken directly from the Region III RBC Table except as indicated in the footnotes.
[a]Micrograms per gram.
[b]Risk-based calculations.
[c]Milligrams per liter; values taken from Table 6-9.
[d]Chemicals of potential concern.
[e]Eliminated as a groundwater COPC if the chemical reached the water table in more than 100 years or did not exceed the tap water RBC.
[f]Calculated according to Region III guidance (USEPA 1995).
[g]Not applicable.

6.1.4.2.1 ***Vadose Zone Model Results.*** The soil screening described in the previous sections indicated that 12 COPCs should be evaluated using the soil-vadose-zone-groundwater screening model at SWMU 8. These COPCs consist of the 12 metals as indicated in Table 6-8. The vadose modeling set-up procedures are described in detail in Section 2.7.2 of this report. This section defines the site-specific parameters and presents the vadose-zone modeling results.

The SWMU 8 site-specific input parameters (Table 6-9) are defined as the vadose zone thickness (H cm), the area of contamination (CA m^2), and the thickness of the contaminated zone (Hcont cm). These input parameters, along with the COPC chemical-specific parameters are used as the input for the GWM-1 and MULTIMED models. All of the GWM-1 spreadsheet models for SWMU 8 are shown in Appendix K. As Appendix K indicates, the above site-specific parameters for SWMU 8 are as follows:

H = 10,668 cm

CA = 4,528 m^2

H cont = 30.48 cm

Other key COPC-specific parameters—the distribution coefficient (Kd), the maximum observed soil concentration (Tc), the initial pore water concentration (C_{init}), and the plume pulse duration (p.d.)—are also shown in Appendix K. All of the GWM-1 spreadsheets associated with the SWMU-specific COPCs are in Appendix K along with the MULTIMED output concentrations. Table 6-9 summarizes these COPC-specific parameters and shows the MULTIMED output for COPC break-through time (time after leaching starts, that the leading edge of the COPC plume reaches the top of the water table) along with the COPC estimated concentration at the time that breakthrough occurs. One key to interpreting these estimates is that the pore water concentration was determined by starting with the maximum observed soil concentration measured at the site (see Table 6-8) and calculating the maximum concentration available for the pore water solution by soil-water partitioning. As explained in Section 2.7.2, the equation used is very dependent on Kd and does not take into account mineral solubility and equilibrium relationships. This is evident by some of the high C_{init} concentrations estimated for several of the COPCs.

6.1.4.2.2 ***Groundwater COPCs.*** As shown in Table 6-9, the MULTIMED output indicates that, within a 100-year time period, no metals will travel downward through the vadose zone and reach the water table. As discussed in detail in Section 2.7.2, the conservative approach was the bases for the model calculations.

Table 6-9 shows the critical input and output parameters and the estimated break-through time for each COPC. This table also shows the estimated concentration associated with the arrival of the leading edge of the COPC plume at the water table. Again, it should be noted that the break-through time calculation does not take into account the various retardation influences, such as biodegradation, volatilization, absorption, adsorption, and mineral-solution equilibrium relationships.

Table 6-9. Summary of Break-Through Vadose Zone Modeling Results and Critical I/O GWM-1 and MULTIMED Parameters for SWMU 8

	COPC Specific Parameters					
Analyte	**Kd[a]**	**Tc (max)[b] (ppm)**	**Cinit[c] (mg/L)**	**Breakthrough Time (yrs)**	**Breakthrough Conc. (mg/L)**	**p.d.[d] (yrs)**
Aluminum	1500	28,800	21.32	>94,000	ND[e]	7873
Antimony	45	143	3.52	35,600	0.0036	237
Arsenic	1	27	27	803	0.000054	6
Barium	52	365	7.78	39,500	0.0032	273
Boron	3	19.3	6.89	2,400	0.0056	16
Cadmium	1.3	1.43	1.13	1,050	0.00046	7
Chromium	1.2	40.2	34.07	953	0.0016	7
Copper	1.4	1,700	1,249.87	1,100	0.0911	8
Lead	4.5	33,000	7,949.45	3,400	0.5815	24
Nickel	150	24	0.1776	>94,000	ND	788
Selenium	1	1.93	1.93	853	0.0019	6
Vanadium	1000	41.4	0.046	>94,000	ND	5249

Note.—Site-specific parameters are as follows: vadose zone thickness (H) = 10,668 cm; area of contaminated soil (CA) = 4,528 m^2; thickness of contaminated soil (Hcont) = 30.48 cm.

[a]The distribution coefficient and is dimensionless.

[b]The maximum observed soil concentration (ppm).

[c]The pore water concentration at the source as conservatively calculated by GWM-1.

[d]The pulse duration as calculated by GWM-1.

[e]Not determined.

In summary, arsenic calculations indicate a break-through time of 803 years at a concentration of 0.000054 mg/L. All other COPCs reach the water table at some time after 803 years as indicated in Table 6-9. Therefore, no groundwater COPCs were selected for quantitative risk evaluation.

6.1.4.3 *Exposure Pathway Assessment*

Exposure is defined as the contact of a receptor with a chemical (USEPA 1989c). Exposure assessment is the estimation of the magnitude, frequency, and duration for each identified route of exposure. The magnitude of an exposure is determined by estimating the amount of chemical available at the receptor exchange boundaries (i.e., lungs, gastrointestinal tract, or skin) during a specified time period.

Section 3.1.2 describes the general tasks comprising the exposure assessment. The specific application of these tasks to SWMU 8 is described below.

6.1.4.3.1 ***Characterization of Exposure Setting.*** The first step in developing exposure scenarios for SWMU 8 was to characterize the site setting in which potential exposures might occur. The characteristics of the site setting influence the types of transport mechanisms and the type of receptor exposure that could occur. The site setting also provides a basis for identifying the potential receptors (either real or, in the case of site redevelopment for alternative use, hypothetical). Both current land use patterns and future land use patterns were examined as part of the characterization.

Current Land Use. As is true for other areas of TEAD-N, public access to SWMU 8 is controlled, thereby precluding transient exposure. SWMU 8 is located in the northwest portion of TEAD-N and will remain part of the depot mission for the foreseeable future. Data were not available on the frequency of use of the Small Arms Firing Range or on repetitive use by the same units. Although use of the range has been discontinued, the possibility exists for occasional use.

Based on the above information, potential receptors under current land use were defined as:

- SWMU-specific laborers and security personnel—Individuals with job descriptions that call for repeated, moderate to heavy labor in the general vicinity of SWMU 8 and staff assigned to maintenance of the perimeter or security personnel that repeatedly work in the vicinity of SWMU 8.

- Military personnel during small arms practice

- Off-site residents—Military personnel and/or civilians living near the depot perimeter.

It was assumed that the SWMU-specific laborer scenario would provide a sufficient upper bound for on-site risk to encompass occasional use by military personnel for small arms practice. Because these other potential receptors would be exposed only intermittently to SWMU 8, SWMU-specific laborers and security personnel were the only on-site receptors evaluated quantitatively as a current-use scenario. This approach provides a series of upper-bound estimates. Off-site residents living near the depot boundary may potentially be exposed to SWMU-related chemicals bound to resuspended particulate. Therefore, the inhalation pathway is quantitatively evaluated for these receptors.

Cattle grazing is permitted at TEAD-N, with grazing allotments competitively bid and leased every 5 years to a single rancher. The current lease is up for rebid in 1996. Grazing at TEAD-N typically occurs between October 15 and May 31, with calving taking place in January. The calves remain at the facility until May 31 when they are either moved to feedlots or to other grazing areas. The calves typically do not return to TEAD-N after their initial exposure, and they are eventually sold as slaughter cattle for human consumption. Distribution is through regional and national distribution networks. The cows are normally utilized as breeding stock and may or may not return to the site during consecutive years. The current lessee brings approximately 1,000 head, mostly heifers, to winter pasture at TEAD-N and maintains summer pasture in Idaho (M. Walker, personal communication with Rust E&I, 1994).

SWMU 8 is part of one grazing allotment currently under lease. Therefore, consumption of beef grazed on the allotment of which SWMU 8 is a part is evaluated in the risk assessment.

Future Land Use. No change in current use is planned for the Small Arms Firing Range; therefore, some exposure scenarios that are analogous to current-use scenarios described above will continue (e.g., SWMU-specific laborers and security personnel). Current BRAC recommendations retain SWMU 8's function as part of the depot's mission. However, should the mission of TEAD-N change in the future, two additional exposure scenarios unique to planned or potential future use of SWMU 8 were developed:

- Skilled laborers—Individuals assigned to short-term construction in the vicinity of SWMU 8 during potential redevelopment.

- Inhabitants of an on-site residence(s)—Individuals who live in residences established at the time that depot property should ever be transferred for redevelopment.

6.1.4.3.2 ***Characterization of Potential Exposure Pathways***. An exposure pathway is the route COPCs take to reach potential receptors. Section 3.1.2.1 and 3.1.2.2 describe the methodology for characterization of exposure pathways. This methodology was then applied to SWMU 8. The following sections describe the potential exposure pathways associated with SWMU 8 for the current and future land use scenarios.

Current Land Use. Currently, the majority of laborers at TEAD-N work 10-hour days with 4-day weeks. A total of 4 weeks off a year for vacation, holidays, and sick leave yields 192 days per year on the job. It is assumed that a laborer could be at any specific SWMU from 2 (CTE) to 10 (RME) hours per day and will incidentally ingest, inhale, or come in contact with surface soil through work-related activities. Military personnel are rotated on assignment an average of every 3 years (S. Culley, personal communication with Rust E&I, 1994). If a laborer is a civilian, the length of assignment could be expected to range as high as 25 years. It is assumed that all of the exposure is from outdoor tasks or activities. Specific parameters relating to ingestion, contact, ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

Potential inhalation of resuspended particulate-bound COPCs by off-site residents was also evaluated. For the current off-site adult resident, it was assumed that at least one parent would spend much of his or her time away from home in activities such as working at another location, household errands, personal care (e.g., medical/dental appointments), or leisure activities. Based on this assumption, the total estimated time an adult spends at home is approximately 15 to 19 hours per day, during which time he or she may inhale particulates generated from surface soil associated with SWMU 8 (while conducting activities such as gardening, mowing, or outdoor sports). For children ages 0 to 18, time activity patterns indicate that they spend an average of approximately 30 hours per week away from home to attend school or day care. The total time a child spends at home averaged over a 7-day week is 20 hours per day. It is assumed that residents spend 2 (RME) to 4 (CTE) weeks away from home on vacation or long holiday weekends. Therefore, the exposure frequency in real time is 335 days per year (CTE) to 350 days per year (RME). Because the contact rate for ingestion and dermal exposure is in daily units, the exposure frequency for these pathways is prorated into 24-hour day equivalents. This ranges from 216 days per year (CTE adult) to 276 days per year (CTE child) and 273 days per year (RME adult) to 288 days per year (RME child) (see Appendix L). Years spent at one residence for the adult/child range from 8 (CTE) to 30 (RME) years based on studies compiled by the USEPA (1989c) and AIHC (1994). Specific parameters relating to ventilation rates, body weights, and bioavailability are given in Appendix L.

As discussed previously, portions of SWMU 8 are allotted for grazing by cattle. The current beef consumer is assumed to eat approximately 1 to 3 ounces of beef a day, of which 44 to 88 percent originates from the grazing allotment at SWMU 8. Specific parameters relating to this pathway are given in Appendix L.

Future Land Use. Based on the future usage of SWMU 8, it is possible that construction may be undertaken to modify military operations at TEAD-N. For these reasons, the future construction worker scenario was evaluated. It is assumed that a construction company could be contracted for a work period ranging from 1 to 3 years and a single worker could be at the site conducting activities outdoors from 2 to 4 months of the year. It is assumed that the worker is active as much as 8 to 10 hours per day and may incidentally ingest, inhale, or become in contact with subsurface soil through construction-related activities. Specific parameters relating to ingestion, contact, ventilation rates, body weight, and absorption or bioavailability are given in Appendix L.

Should the future planned use of SWMU 7 change and the property be zoned for potential residential development, the future on-site adult and child resident will also be evaluated for the future land use scenario. For the future on-site adult resident, it was assumed that at least one parent would spend much of his or her time away from home in activities such as working at another location, household errands, personal care (e.g., medical/dental appointments), or leisure activities. Based on this assumption, the total estimated time an adult will spend at home is approximately 15 to 19 hours per day, during which time he or she may incidentally ingest, inhale, or come in contact with surface soil while conducting activities such as gardening, mowing, or outdoor sports. It is also expected that the future on-site resident will grow and harvest vegetables and fruits from a home garden. For children and adolescents ages 0 to 18, time activity patterns indicate that they spend an average of approximately 30 hours per week away from home to attend school or day care. The total time a child spends at home, averaged over a 7-day week, is approximately 20 hours per day. It is assumed that residents spend 2 (RME) to 4 (CTE) weeks away from home on vacation or long holiday weekends. Therefore, the exposure frequency in real time is 335 days per year (CTE) to 350 days per year (RME). Because the contact rate for ingestion and dermal exposure is in daily units, the exposure frequency for these pathways is prorated into 24-hour-day equivalents. This ranges from 216 days per year (CTE adult) to 276 days per year (CTE child) and from 273 days per year (RME adult) to 288 days per year (RME child) (see Appendix L). Years spent at one residence for the adult/child range from 8 (CTE) to 30 (RME) years based on studies compiled by the USEPA (1989c) and AIHC (1994). Specific parameters relating to ingestion, contact, ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

6.1.4.3.3 ***Exposure Point Concentrations.*** The EPC is defined as the concentration of a COPC in an exposure medium that is contacted over a real or hypothetical exposure duration. EPCs at SWMU 8 were evaluated for both current and future use. Estimation of EPCs is fully described in Appendix L. For brevity, only information specific to SWMU 8 is presented in the following sections.

As discussed in Section 6.1.4.1 and 6.1.4.2, four areas of concern were evaluated for SWMU 8. Based on the screening methodology, EPCs were calculated for surface and/or subsurface soils for three of the areas of concern—Firing Lines, Drainage Area, and Bullet Stops—as well as the SWMU as a whole.

Current Land Use. EPCs for surface soil ingestion and dermal contact by the SWMU 8 personnel were estimated for the CTE and RME exposure scenario using data from the Phase II RI. Because the duties of on-site personnel vary, EPCs were developed for each area of concern and the SWMU as a whole to encompass all potential exposure scenarios for this receptor.

EPCs in beef were estimated based on the EPCs in surface soil as discussed above. Details of the estimation of beef tissue uptake from forage are presented in Appendix L. Air EPCs for on-site personnel and off-site residents were estimated using USEPA's SCREEN2 model. Air emissions were not evaluated for each specific area of concern. It was assumed that the

SWMU, as a whole, was the main source for air emission generation for all on- and off-site receptors. Details of the estimation of emission rates from surface soils and dispersion modeling are described in Appendix N. Tables 6-10 through 6-16 present the EPCs for on-site personnel and off-site residents associated with SWMU 8.

Future Land Use. EPCs for subsurface soil ingestion and dermal contact by future construction workers were estimated using the same methods as those used for the on-site personnel under the current land use scenario (see Appendix L) and EPCs for inhalation of particulates generated from subsurface soil were modeled (see Appendix N). However, it was assumed that the construction projects would be limited in size; therefore, potential exposure pathways are not evaluated for the SWMU as a whole but are limited to the specific areas of concern (Tables 6-10 through 6-16).

EPCs for surface soil ingestion, dermal contact with surface soil, and ingestion of produce by hypothetical future on-site residents at SWMU 8 were estimated using methods described in Appendix L. EPCs for inhalation of particulates were modeled, as described in Appendix N. The EPCs are given in Tables 6-10 through 6-16.

6.1.4.3.4 ***Estimation of Chemical Intakes.*** The exposure models described in detail in Appendix L together with EPCs listed in Tables 6-10 through 6-16 were used to estimate intake for the potential exposure scenarios. Note that averaging time differs for carcinogens and noncarcinogens. Because exposure to soil is likely to be higher for young children and adolescents ages 0 to 18 years, intakes were calculated separately from the adults. Estimates of exposure intakes are given in Tables 6-17 through 6-40.

6.1.4.4 *Toxicity Assessment*

Information of the toxicological effects of carcinogenic and systemic toxicants are summarized in Appendix M. This toxicity assessment includes brief toxicity profiles on data listed in USEPA's IRIS database and published in HEAST (USEPA 1994c). These profiles describe the acute, chronic, and carcinogenic health effects associated with SWMU-related chemicals. Toxicity values for COPCs associated with SWMU 8 are summarized in Tables 6-17 through 6-40.

6.1.4.5 *Risk Characterization*

This section provides a characterization of the potential health risks using the intake of chemicals associated with three areas of concern associated with SWMU 8—Firing Lines, Drainage Area, and Bullet Stops. In addition, potential risks were evaluated for SWMU 8 as a whole. The risk characterization compares estimated potential ILCRs with reasonable levels of risk for potential carcinogens (see Section 3.1.4.1) and the estimated daily intake of systemic toxicants with appropriate reference levels. Some carcinogenic chemicals may also pose a systemic hazard, and these potential hazards are characterized as for other systemic toxicants. Each of the areas associated with SWMU 8 are discussed separately below.

Table 6-10. Adult Exposure Point Concentrations for the Firing Line Area of Concern for SWMU 8

Chemical	Exposure Point Concentration	
	CTE[(a)]	RME[(b)]
Future Land Use [(c)]		
Subsurface Soil (mg/kg)		
Chromium	40.2	40.2
Air ($\mu g/m^3$)		
Chromium	0.13	0.13

[a]Central tendency exposure.
[b]Reasonable maximum exposure.
[c]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Table 6-11. Adult Exposure Point Concentrations for the Drainage Area of Concern Associated with SWMU 8

Chemical	Exposure Point Concentration CTE[a]	RME[b]
Current Land Use		
Surface Soil (mg/kg)		
Aluminum	20,623	20,623
Air ($\mu g/m^3$)		
Aluminum	0.71	0.71
Antimony	0.0013	0.0013
Arsenic	0.00036	0.00036
Copper	0.0021	0.0021
Lead	0.022	0.022
Future Land Use [c]		
Surface Soil (mg/kg)[d]		
Air ($\mu g/m^3$)[d]		
Tubers/Fruits (mg/kg)		
Aluminum	2.95	2.95
Leafy Vegetables (mg/kg)		
Aluminum	5.77	5.77

[a]Central tendency exposure.
[b]Reasonable maximum exposure.
[c]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.
[d]Future use concentrations are the same as for the current use scenarios.

Table 6-12. Child Exposure Point Concentrations for the Drainage Area of Concern Associated with SWMU 8

Chemical	Exposure Point Concentration CTE[(a)]	Exposure Point Concentration RME[(b)]
Future Land Use [(c)]		
Surface Soil (mg/kg)		
Aluminum	20,623	20,623
Air ($\mu g/m^3$)		
Aluminum	0.71	0.71
Antimony	0.0013	0.0013
Arsenic	0.00036	0.00036
Copper	0.0021	0.0021
Lead	0.022	0.022
Tubers/Fruits (mg/kg)		
Aluminum	2.95	2.95
Leafy Vegetables (mg/kg)		
Aluminum	5.77	5.77

[a]Central tendency exposure.
[b]Reasonable maximum exposure.
[c]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Table 6-13. Adult Exposure Point Concentrations for the Bullet Stop Area of Concern Associated with SWMU 8

Chemical	**Exposure Point Concentration** CTE[a]	RME[b]
Current Land Use		
Surface Soil (mg/kg)		
Antimony	35.2	35.2
Arsenic	10.3	10.3
Copper	375	375
Lead	5,736	5,736
Air ($\mu g/m^3$)		
Aluminum	0.71	0.71
Antimony	0.0013	0.0013
Arsenic	0.00036	0.00036
Copper	0.0021	0.0021
Lead	0.022	0.022
Future Land Use [c]		
Surface Soil (mg/kg)[d]		
Air ($\mu g/m^3$)[d]		
Subsurface Soil (mg/kg)		
Lead	172	172
Air Emissions from Subsurface Soil ($\mu g/m^3$)		
Lead	0.54	.0.54
Tubers/Fruits (mg/kg)		
Antimony	0.23	0.23
Arsenic	0.014	0.014
Copper	20.6	20.6
Lead	11.4	11.4
Leafy Vegetables (mg/kg)		
Antimony	0.49	0.49
Arsenic	0.029	0.029
Copper	10.5	10.5
Lead	18.1	18.1

[a]Central tendency exposure.
[b]Reasonable maximum exposure.
[c]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.
[d]Future use concentrations are the same as for the current use scenarios.

Table 6-14. Child Exposure Point Concentrations for the Bullet Stop Area of Concern for SWMU 8

Chemical	Exposure Point Concentration CTE[(a)]	RME[(b)]
Future Land Use [(c)]		
Surface Soil (mg/kg)		
Antimony	35.2	35.2
Arsenic	10.3	10.3
Copper	375	375
Lead	5,736	5,736
Air ($\mu g/m^3$)		
Aluminum	0.71	0.71
Antimony	0.0013	0.0013
Arsenic	0.00036	0.00036
Copper	0.0021	0.0021
Lead	0.022	0.022
Tubers/Fruits (mg/kg)		
Antimony	0.23	0.23
Arsenic	0.014	0.014
Copper	20.6	20.6
Lead	11.4	11.4
Leafy Vegetables (mg/kg)		
Antimony	0.49	0.49
Arsenic	0.029	0.029
Copper	10.5	10.5
Lead	18.1	18.1

[a]Central tendency exposure.
[b]Reasonable maximum exposure.
[c]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Table 6-15. Adult Exposure Point Concentrations for SWMU 8 as a Whole

	Exposure Point Concentration	
Chemical	**CTE[(a)]**	**RME[(b)]**
Current Land Use		
Surface Soil (mg/kg)		
Aluminum	17,438	17,438
Antimony	31.5	31.5
Arsenic	8.7	8.7
Copper	52.3	52.3
Lead	537	537
On-site Air ($\mu g/m^3$)		
Aluminum	0.71	0.71
Antimony	0.0013	0.0013
Arsenic	0.00036	0.00036
Copper	0.0021	0.0021
Lead	0.022	0.022
Off-site Air ($\mu g/m^3$)		
Aluminum	0.32	0.32
Antimony	0.00058	0.00058
Arsenic	0.00016	0.00016
Copper	0.00096	0.00096
Lead	0.0099	0.0099

[a]Central tendency exposure.
[b]Reasonable maximum exposure.

Table 6-16. Adult and Child Exposure Point Concentrations for Beef Tissue from Cattle Associated with Grazing Allotment 2 (SWMU 8)

	Exposure Point Concentration	
Chemical	**CTE[a]**	**RME[b]**
Current Land Use		
Beef Tissue - Adult (mg/kg)		
Aluminum	0.063	0.063
Antimony	0.00012	0.00012
Arsenic	0.000030	0.000030
Copper	0.0027	0.0027
Lead	0.000097	0.000097
Beef Tissue - Child (mg/kg)		
Aluminum	0.063	0.063
Antimony	0.00012	0.00012
Arsenic	0.000030	0.000030
Copper	0.0027	0.0027
Lead	0.000097	0.000097

[a]Central tendency exposure.
[b]Reasonable maximum exposure.

Table 6-17. Summary of Potential Carcinogenic Risk Results for the Future Construction Worker for SWMU 8 (Firing Lines)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) (mg/kg-day)-1	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Subsurface Soil					
Chromium	4.0E+01	NA(d)	NA	NA	
				NA	NA
Dermal Contact with Subsurface Soil					
Chromium	4.0E+01	NA	NA	NA	
				NA	NA
Inhalation of Particulates					
Chromium	1.3E-04	1.2E-08	4.2E+01	5.2E-07	
			Pathway Total:	5.2E-07	100%
			Total CTE ILCR:	5.2E-07	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Subsurface Soil					
Chromium	4.0E+01	NA	NA	NA	
				NA	NA
Dermal Contact with Subsurface Soil					
Chromium	4.0E+01	NA	NA	NA	
				NA	NA
Inhalation of Particulates					
Chromium	1.3E-04	1.6E-07	4.2E+01	6.8E-06	
			Pathway Total:	6.8E-06	100%
			Total RME ILCR:	6.8E-06	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-18. Summary of Potential Carcinogenic Risk Results for the Current/Future On-site Laborer for SWMU 8 (Drainage Area)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Aluminum	2.1E+04	NA[d]	NA	NA	
			Pathway Total:	NA	NA
Dermal Contact with Surface Soil					
Aluminum	2.1E+04	NA	NA	NA	
			Pathway Total:	NA	NA
Inhalation of Particulates					
Aluminum	7.1E-04	NA	NA	NA	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	1.6E-11	1.5E+01	2.4E-10	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	2.4E-10	100%
			Total CTE ILCR:	2.4E-10	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Aluminum	2.1E+04	NA	NA	NA	
			Pathway Total:	NA	NA
Dermal Contact with Surface Soil					
Aluminum	2.1E+04	NA	NA	NA	
			Pathway Total:	NA	NA
Inhalation of Particulates					
Aluminum	7.1E-04	NA	NA	NA	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	3.9E-09	1.5E+01	5.9E-08	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	5.9E-08	100%
			Total RME ILCR:	5.9E-08	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-19. Summary of Potential Carcinogenic Risk Results for the Future On-site Adult Resident for SWMU 8 (Drainage Area)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Aluminum	2.1E+04	NA(d)	NA	NA	
			Pathway Total:	NA	NA
Dermal Contact with Surface Soil					
Aluminum	2.1E+04	NA	NA	NA	
			Pathway Total:	NA	NA
Inhalation of Particulates					
Aluminum	7.1E-04	NA	NA	NA	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	1.3E-09	1.5E+01	1.9E-08	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	1.9E-08	100%
Ingestion of Leafy Vegetables					
Aluminum	5.8E+00	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Tubers and Fruits					
Aluminum	3.0E+00	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE ILCR:	1.9E-08	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Aluminum	2.1E+04	NA	NA	NA	
			Pathway Total:	NA	NA
Dermal Contact with Surface Soil					
Aluminum	2.1E+04	NA	NA	NA	
			Pathway Total:	NA	NA
Inhalation of Particulates					
Aluminum	7.1E-04	NA	NA	NA	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	6.8E-09	1.5E+01	1.0E-07	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	1.0E-07	100%
Ingestion of Leafy Vegetables					
Aluminum	5.8E+00	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Tubers and Fruits					
Aluminum	3.0E+00	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME ILCR:	1.0E-07	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-20. Summary of Potential Carcinogenic Risk Results for the Future On-site Child Resident for SWMU 8 (Drainage Area)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Aluminum	2.1E+04	NA[d]	NA	NA	
			Pathway Total:	NA	NA
Dermal Contact with Surface Soil					
Aluminum	2.1E+04	NA	NA	NA	
			Pathway Total:	NA	NA
Inhalation of Particulates					
Aluminum	7.1E-04	NA	NA	NA	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	6.6E-09	1.5E+01	9.9E-08	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	9.9E-08	100%
Ingestion of Leafy Vegetables					
Aluminum	5.8E+00	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Tubers and Fruits					
Aluminum	3.0E+00	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE ILCR:	9.9E-08	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Aluminum	2.1E+04	NA	NA	NA	
			Pathway Total:	NA	NA
Dermal Contact with Surface Soil					
Aluminum	2.1E+04	NA	NA	NA	
			Pathway Total:	NA	NA
Inhalation of Particulates					
Aluminum	7.1E-04	NA	NA	NA	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	1.1E-08	1.5E+01	1.6E-07	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	1.6E-07	100%
Ingestion of Leafy Vegetables					
Aluminum	5.8E+00	NA	NA	NA	
			Pathway Total:	NA	NA
Ingestion of Tubers and Fruits					
Aluminum	3.0E+00	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME ILCR:	1.6E-07	100%

[a] Units for the inhalation pathway are mg/m^3.
[b] See Appendix L for sources and methodology on estimating a daily intake value.
[c] See Appendix M for sources and methodology of toxicity values.
[d] NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-21. Summary of Potential Carcinogenic Risk Results for the Current/Future On-site Laborer for SWMU 8 (Bullet Stops)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] (mg/kg-day)$^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Antimony	3.5E+01	NA[d]	NA	NA	
Arsenic	1.0E+01	9.8E-10	1.5E+00	1.5E-09	
Copper	3.8E+02	NA	NA	NA	
Lead	5.7E+03	NA	NA	NA	
			Pathway Total:	1.5E-09	82%
Dermal Contact with Surface Soil					
Antimony	3.5E+01	NA	NA	NA	
Arsenic	1.0E+01	4.9E-11	1.5E+00	7.5E-11	
Copper	3.8E+02	NA	NA	NA	
Lead	5.7E+03	NA	NA	NA	
			Pathway Total:	7.5E-11	4%
Inhalation of Particulates					
Aluminum	7.1E-04	NA	NA	NA	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	1.6E-11	1.5E+01	2.4E-10	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	2.4E-10	14%
			Total CTE ILCR:	1.8E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Antimony	3.5E+01	NA	NA	NA	
Arsenic	1.0E+01	7.8E-07	1.5E+00	1.2E-06	
Copper	3.8E+02	NA	NA	NA	
Lead	5.7E+03	NA	NA	NA	
			Pathway Total:	1.2E-06	86%
Dermal Contact with Surface Soil					
Antimony	3.5E+01	NA	NA	NA	
Arsenic	1.0E+01	9.1E-08	1.5E+00	1.4E-07	
Copper	3.8E+02	NA	NA	NA	
Lead	5.7E+03	NA	NA	NA	
			Pathway Total:	1.4E-07	10%
Inhalation of Particulates					
Aluminum	7.1E-04	NA	NA	NA	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	3.9E-09	1.5E+01	5.9E-08	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	5.9E-08	4%
			Total RME ILCR:	1.4E-06	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-22. Summary of Potential Carcinogenic Risk Results for the Future On-site Adult Resident for SWMU 8 (Bullet Stops)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Antimony	3.5E+01	NA[d]	NA	NA	
Arsenic	1.0E+01	9.0E-08	1.5E+00	1.4E-07	
Copper	3.8E+02	NA	NA	NA	
Lead	5.7E+03	NA	NA	NA	
			Pathway Total:	1.4E-07	7%
Dermal Contact with Surface Soil					
Antimony	3.5E+01	NA	NA	NA	
Arsenic	1.0E+01	4.5E-09	1.5E+00	6.9E-09	
Copper	3.8E+02	NA	NA	NA	
Lead	5.7E+03	NA	NA	NA	
			Pathway Total:	6.9E-09	0%
Inhalation of Particulates					
Aluminum	7.1E-04	NA	NA	NA	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	1.3E-09	1.5E+01	1.9E-08	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	1.9E-08	1%
Ingestion of Leafy Vegetables					
Antimony	4.9E-01	NA	NA	NA	
Arsenic	2.9E-02	4.3E-07	1.5E+00	6.4E-07	
Copper	1.1E+01	NA	NA	NA	
Lead	1.8E+01	NA	NA	NA	
			Pathway Total:	6.4E-07	35%
Ingestion of Tubers and Fruits					
Antimony	2.3E-01	NA	NA	NA	
Arsenic	1.4E-02	6.8E-07	1.5E+00	1.0E-06	
Copper	2.1E+01	NA	NA	NA	
Lead	1.1E+01	NA	NA	NA	
			Pathway Total:	1.0E-06	56%
			Total CTE ILCR:	1.8E-06	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Antimony	3.5E+01	NA	NA	NA	
Arsenic	1.0E+01	2.1E-06	1.5E+00	3.2E-06	
Copper	3.8E+02	NA	NA	NA	
Lead	5.7E+03	NA	NA	NA	
			Pathway Total:	3.2E-06	13%
Dermal Contact with Surface Soil					
Antimony	3.5E+01	NA	NA	NA	
Arsenic	1.0E+01	2.5E-07	1.5E+00	3.8E-07	
Copper	3.8E+02	NA	NA	NA	
Lead	5.7E+03	NA	NA	NA	
			Pathway Total:	3.8E-07	1%
Inhalation of Particulates					
Aluminum	7.1E-04	NA	NA	NA	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	6.8E-09	1.5E+01	1.0E-07	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	1.0E-07	0%
Ingestion of Leafy Vegetables					
Antimony	4.9E-01	NA	NA	NA	
Arsenic	2.9E-02	5.6E-06	1.5E+00	8.5E-06	
Copper	1.1E+01	NA	NA	NA	
Lead	1.8E+01	NA	NA	NA	
			Pathway Total:	8.5E-06	33%
Ingestion of Tubers and Fruits					
Antimony	2.3E-01	NA	NA	NA	
Arsenic	1.4E-02	8.9E-06	1.5E+00	1.3E-05	
Copper	2.1E+01	NA	NA	NA	
Lead	1.1E+01	NA	NA	NA	
			Pathway Total:	1.3E-05	52%
			Total RME ILCR:	2.6E-05	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-23. Summary of Potential Carcinogenic Risk Results for the Future On-site Child Resident for SWMU 8 (Bullet Stops)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Antimony	3.5E+01	NA[d]	NA	NA	
Arsenic	1.0E+01	4.1E-07	1.5E+00	6.1E-07	
Copper	3.8E+02	NA	NA	NA	
Lead	5.7E+03	NA	NA	NA	
			Pathway Total:	6.1E-07	18%
Dermal Contact with Surface Soil					
Antimony	3.5E+01	NA	NA	NA	
Arsenic	1.0E+01	7.6E-09	1.5E+00	1.2E-08	
Copper	3.8E+02	NA	NA	NA	
Lead	5.7E+03	NA	NA	NA	
			Pathway Total:	1.2E-08	0%
Inhalation of Particulates					
Aluminum	7.1E-04	NA	NA	NA	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	6.6E-09	1.5E+01	9.9E-08	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	9.9E-08	3%
Ingestion of Leafy Vegetables					
Antimony	4.9E-01	NA	NA	NA	
Arsenic	2.9E-02	7.0E-07	1.5E+00	1.0E-06	
Copper	1.1E+01	NA	NA	NA	
Lead	1.8E+01	NA	NA	NA	
			Pathway Total:	1.0E-06	31%
Ingestion of Tubers and Fruits					
Antimony	2.3E-01	NA	NA	NA	
Arsenic	1.4E-02	1.1E-06	1.5E+00	1.7E-06	
Copper	2.1E+01	NA	NA	NA	
Lead	1.1E+01	NA	NA	NA	
			Pathway Total:	1.7E-06	48%
			Total CTE ILCR:	3.4E-06	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Antimony	3.5E+01	NA	NA	NA	
Arsenic	1.0E+01	4.6E-06	1.5E+00	6.8E-06	
Copper	3.8E+02	NA	NA	NA	
Lead	5.7E+03	NA	NA	NA	
			Pathway Total:	6.8E-06	32%
Dermal Contact with Surface Soil					
Antimony	3.5E+01	NA	NA	NA	
Arsenic	1.0E+01	1.0E-07	1.5E+00	1.6E-07	
Copper	3.8E+02	NA	NA	NA	
Lead	5.7E+03	NA	NA	NA	
			Pathway Total:	1.6E-07	1%
Inhalation of Particulates					
Aluminum	7.1E-04	NA	NA	NA	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	1.1E-08	1.5E+01	1.6E-07	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	1.6E-07	1%
Ingestion of Leafy Vegetables					
Antimony	4.9E-01	NA	NA	NA	
Arsenic	2.9E-02	3.7E-06	1.5E+00	5.6E-06	
Copper	1.1E+01	NA	NA	NA	
Lead	1.8E+01	NA	NA	NA	
			Pathway Total:	5.6E-06	26%
Ingestion of Tubers and Fruits					
Antimony	2.3E-01	NA	NA	NA	
Arsenic	1.4E-02	5.9E-06	1.5E+00	8.8E-06	
Copper	2.1E+01	NA	NA	NA	
Lead	1.1E+01	NA	NA	NA	
			Pathway Total:	8.8E-06	41%
			Total RME ILCR:	2.2E-05	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-24. Summary of Potential Carcinogenic Risk Results for the Current/Future On-site Laborer for SWMU 8 as a Whole

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Aluminum	1.7E+04	NA(d)	NA	NA	
Antimony	3.2E+01	NA	NA	NA	
Arsenic	8.7E+00	8.3E-10	1.5E+00	1.2E-09	
Copper	5.2E+01	NA	NA	NA	
Lead	5.4E+02	NA	NA	NA	
			Pathway Total:	1.2E-09	80%
Dermal Contact with Surface Soil					
Aluminum	1.7E+04	NA	NA	NA	
Antimony	3.2E+01	NA	NA	NA	
Arsenic	8.7E+00	4.1E-11	1.5E+00	6.3E-11	
Copper	5.2E+01	NA	NA	NA	
Lead	5.4E+02	NA	NA	NA	
			Pathway Total:	6.3E-11	4%
Inhalation of Particulates					
Aluminum	7.1E-04	NA	NA	NA	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	1.6E-11	1.5E+01	2.4E-10	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	2.4E-10	16%
			Total CTE ILCR:	1.5E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Aluminum	1.7E+04	NA	NA	NA	
Antimony	3.2E+01	NA	NA	NA	
Arsenic	8.7E+00	6.6E-07	1.5E+00	9.9E-07	
Copper	5.2E+01	NA	NA	NA	
Lead	5.4E+02	NA	NA	NA	
			Pathway Total:	9.9E-07	85%
Dermal Contact with Surface Soil					
Aluminum	1.7E+04	NA	NA	NA	
Antimony	3.2E+01	NA	NA	NA	
Arsenic	8.7E+00	7.7E-08	1.5E+00	1.2E-07	
Copper	5.2E+01	NA	NA	NA	
Lead	5.4E+02	NA	NA	NA	
			Pathway Total:	1.2E-07	10%
Inhalation of Particulates					
Aluminum	7.1E-04	NA	NA	NA	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	3.9E-09	1.5E+01	5.9E-08	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	5.9E-08	5%
			Total RME ILCR:	1.2E-06	100%

[a] Units for the inhalation pathway are mg/m^3.
[b] See Appendix L for sources and methodology on estimating a daily intake value.
[c] See Appendix M for sources and methodology of toxicity values.
[d] NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-25. Summary of Potential Carcinogenic Risk Results for the Current Off-site Adult Resident for SWMU 8 as a Whole

Chemical	Exposure Point Concentration (mg/m^3)	Daily Carcinogenic Intake(a) (mg/kg-day)	Carcinogenic Slope Factor(b) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Inhalation of Particulates					
Aluminum	3.2E-04	NA(c)	NA	NA	
Antimony	5.8E-07	NA	NA	NA	
Arsenic	1.6E-07	5.8E-10	1.5E+01	8.7E-09	
Copper	9.6E-07	NA	NA	NA	
Lead	9.9E-06	NA	NA	NA	
			Total CTE ILCR:	8.7E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Inhalation of Particulates					
Aluminum	3.2E-04	NA	NA	NA	
Antimony	5.8E-07	NA	NA	NA	
Arsenic	1.6E-07	3.1E-09	1.5E+01	4.6E-08	
Copper	9.6E-07	NA	NA	NA	
Lead	9.9E-06	NA	NA	NA	
			Total RME ILCR:	4.6E-08	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.

[b]See Appendix M for sources and methodology of toxicity values.

[c]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-26. Summary of Potential Carcinogenic Risk Results for the Current Off-site Child Resident for SWMU 8 as a Whole

Chemical	Exposure Point Concentration (mg/m^3)	Daily Carcinogenic Intake[a] (mg/kg-day)	Carcinogenic Slope Factor[b] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Inhalation of Particulates					
Aluminum	3.2E-04	NA[c]	NA	NA	
Antimony	5.8E-07	NA	NA	NA	
Arsenic	1.6E-07	3.0E-09	1.5E+01	4.5E-08	
Copper	9.6E-07	NA	NA	NA	
Lead	9.9E-06	NA	NA	NA	
			Total CTE ILCR:	4.5E-08	100%
Reasonable Maximum Exposure (RME) Scenario					
Inhalation of Particulates					
Aluminum	3.2E-04	NA	NA	NA	
Antimony	5.8E-07	NA	NA	NA	
Arsenic	1.6E-07	4.8E-09	1.5E+01	7.2E-08	
Copper	9.6E-07	NA	NA	NA	
Lead	9.9E-06	NA	NA	NA	
			Total RME ILCR:	7.2E-08	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.

[b]See Appendix M for sources and methodology of toxicity values.

[c]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-27. Summary of Potential Carcinogenic Risk Results for the Current Adult Beef Consumer of Cattle from Grazing Allotment 2 (SWMU 8)

Chemical	Exposure Point Concentration (mg/kg)	Daily Carcinogenic Intake(a) (mg/kg-day)	Carcinogenic Slope Factor(b) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Beef					
Aluminum	6.3E-02	NA[d]	NA	NA	
Antimony	1.2E-04	NA	NA	NA	
Arsenic	3.0E-05	7.8E-10	1.5E+00	1.2E-09	
Copper	2.7E-03	NA	NA	NA	
Lead	9.7E-05	NA	NA	NA	
			Total CTE ILCR:	1.2E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Beef					
Aluminum	6.3E-02	NA	NA	NA	
Antimony	1.2E-04	NA	NA	NA	
Arsenic	3.0E-05	1.2E-08	1.5E+00	1.8E-08	
Copper	2.7E-03	NA	NA	NA	
Lead	9.7E-05	NA	NA	NA	
			Total RME ILCR:	1.8E-08	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.

[b]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-28. Summary of Potential Carcinogenic Risk Results for the Child Beef Consumer of Cattle for Grazing Allotment 2 (SWMU 8)

Chemical	Exposure Point Concentration (mg/kg)	Daily Carcinogenic Intake(a) (mg/kg-day)	Carcinogenic Slope Factor(b) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Beef					
Aluminum	6.3E-02	NA[d]	NA	NA	
Antimony	1.2E-04	NA	NA	NA	
Arsenic	3.0E-05	1.7E-09	1.5E+00	2.6E-09	
Copper	2.7E-03	NA	NA	NA	
Lead	9.7E-05	NA	NA	NA	
			Total CTE ILCR:	2.6E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Beef					
Aluminum	6.3E-02	NA	NA	NA	
Antimony	1.2E-04	NA	NA	NA	
Arsenic	3.0E-05	1.1E-08	1.5E+00	1.7E-08	
Copper	2.7E-03	NA	NA	NA	
Lead	9.7E-05	NA	NA	NA	
			Total RME ILCR:	1.7E-08	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.

[b]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-29. Summary of Potential Systemic Effects for the Future Construction Worker for SWMU 8 (Firing Lines)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Subsurface Soil					
Chromium	4.0E+01	2.2E-05	2.0E-02	1.1E-03	
			Pathway Total:	1.1E-03	93%
Dermal Contact with Subsurface Soil					
Chromium	4.0E+01	7.8E-08	1.0E-03	7.8E-05	
			Pathway Total:	7.8E-05	7%
Inhalation of Particulates					
Chromium	1.3E-04	NA(d)	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	1.2E-03	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Subsurface Soil					
Chromium	4.0E+01	1.0E-04	2.0E-02	5.1E-03	
			Pathway Total:	5.1E-03	74%
Dermal Contact with Subsurface Soil					
Chromium	4.0E+01	1.8E-06	1.0E-03	1.8E-03	
			Pathway Total:	1.8E-03	26%
Inhalation of Particulates					
Chromium	1.3E-04	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	7.0E-03	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-30. Summary of Potential Systemic Effects for the Current/Future On-site Laborer for SWMU 8 (Drainage Area)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Aluminum	2.1E+04	4.9E-05	1.0E+00	4.9E-05	
			Pathway Total:	4.9E-05	8%
Dermal Contact with Surface Soil					
Aluminum	2.1E+04	2.5E-06	2.0E-01	1.2E-05	
			Pathway Total:	1.2E-05	2%
Inhalation of Particulates					
Aluminum	7.1E-04	8.1E-07	1.4E-03	5.8E-04	
Antimony	1.3E-06	NA[d]	NA	NA	
Arsenic	3.6E-07	NA	NA	NA	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	5.8E-04	90%
			Total CTE HI:	6.4E-04	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Aluminum	2.1E+04	4.9E-05	1.0E+00	4.9E-05	
			Pathway Total:	4.9E-05	0%
Dermal Contact with Surface Soil					
Aluminum	2.1E+04	4.9E-05	2.0E-01	2.5E-04	
			Pathway Total:	2.5E-04	1%
Inhalation of Particulates					
Aluminum	7.1E-04	2.3E-05	1.4E-03	1.7E-02	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	NA	NA	NA	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	1.7E-02	98%
			Total RME HI:	1.7E-02	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-31. Summary of Potential Systemic Effects for the Future On-site Adult Resident for SWMU 8 (Drainage Area)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Aluminum	2.1E+04	1.7E-03	1.0E+00	1.7E-03	
			Pathway Total:	1.7E-03	8%
Dermal Contact with Surface Soil					
Aluminum	2.1E+04	8.5E-05	2.0E-01	4.2E-04	
			Pathway Total:	4.2E-04	2%
Inhalation of Particulates					
Aluminum	7.1E-04	2.4E-05	1.4E-03	1.7E-02	
Antimony	1.3E-06	NA[d]	NA	NA	
Arsenic	3.6E-07	NA	NA	NA	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	1.7E-02	80%
Ingestion of Leafy Vegetables					
Aluminum	5.8E+00	8.1E-04	1.0E+00	8.1E-04	
			Pathway Total:	8.1E-04	4%
Ingestion of Tubers and Fruits					
Aluminum	3.0E+00	1.4E-03	1.0E+00	1.4E-03	
			Pathway Total:	1.4E-03	6%
			Total CTE HI:	2.2E-02	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Aluminum	2.1E+04	1.1E-02	1.0E+00	1.1E-02	
			Pathway Total:	1.1E-02	22%
Dermal Contact with Surface Soil					
Aluminum	2.1E+04	1.2E-03	2.0E-01	6.2E-03	
			Pathway Total:	6.2E-03	13%
Inhalation of Particulates					
Aluminum	7.1E-04	3.4E-05	1.4E-03	2.4E-02	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	NA	NA	NA	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	2.4E-02	50%
Ingestion of Leafy Vegetables					
Aluminum	5.8E+00	2.8E-03	1.0E+00	2.8E-03	
			Pathway Total:	2.8E-03	6%
Ingestion of Tubers and Fruits					
Aluminum	3.0E+00	4.9E-03	1.0E+00	4.9E-03	
			Pathway Total:	4.9E-03	10%
			Total RME HI:	4.9E-02	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-32. Summary of Potential Systemic Effects for the Future On-site Child Resident for SWMU 8 (Drainage Area)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Aluminum	2.1E+04	7.7E-03	1.0E+00	7.7E-03	
			Pathway Total:	7.7E-03	8%
Dermal Contact with Surface Soil					
Aluminum	2.1E+04	1.4E-04	1.0E+00	1.4E-04	
			Pathway Total:	1.4E-04	0%
Inhalation of Particulates					
Aluminum	7.1E-04	1.2E-04	1.4E-03	8.8E-02	
Antimony	1.3E-06	NA(d)	NA	NA	
Arsenic	3.6E-07	NA	NA	NA	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	8.8E-02	89%
Ingestion of Leafy Vegetables					
Antimony	5.8E+00	1.3E-03	1.0E+00	1.3E-03	
			Pathway Total:	1.3E-03	1%
Ingestion of Tubers and Fruits					
Antimony	3.0E+00	2.3E-03	1.0E+00	2.3E-03	
			Pathway Total:	2.3E-03	2%
			Total CTE HI:	1.0E-01	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Aluminum	2.1E+04	3.8E-02	1.0E+00	3.8E-02	
			Pathway Total:	3.8E-02	33%
Dermal Contact with Surface Soil					
Aluminum	2.1E+04	8.7E-04	2.0E-01	4.4E-03	
			Pathway Total:	4.4E-03	4%
Inhalation of Particulates					
Aluminum	7.1E-04	9.0E-05	1.4E-03	6.4E-02	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	NA	NA	NA	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	6.4E-02	56%
Ingestion of Leafy Vegetables					
Aluminum	5.8E+00	3.1E-03	1.0E+00	3.1E-03	
			Pathway Total:	3.1E-03	3%
Ingestion of Tubers and Fruits					
Aluminum	3.0E+00	5.3E-03	1.0E+00	5.3E-03	
			Pathway Total:	5.3E-03	5%
			Total RME HI:	1.1E-01	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-33. Summary of Potential Systemic Effects for the Current/Future On-site Laborer for SWMU 8 (Bullet Stops)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Antimony	3.5E+01	8.4E-08	4.0E-04	2.1E-04	
Arsenic	1.0E+01	2.5E-08	3.0E-04	8.2E-05	
Copper	3.8E+02	8.9E-07	4.0E-02	2.2E-05	
Lead	5.7E+03	NA[d]	NA	NA	
			Pathway Total:	3.1E-04	33%
Dermal Contact with Surface Soil					
Antimony	3.5E+01	4.2E-09	8.0E-05	5.2E-05	
Arsenic	1.0E+01	1.2E-09	2.9E-04	4.2E-06	
Copper	3.8E+02	NA	NA	NA	
Lead	5.7E+03	NA	NA	NA	
			Pathway Total:	5.7E-05	6%
Inhalation of Particulates					
Aluminum	7.1E-04	8.1E-07	1.4E-03	5.8E-04	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	NA	NA	NA	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	5.8E-04	61%
			Total CTE HI:	9.5E-04	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Antimony	3.5E+01	8.0E-06	4.0E-04	2.0E-02	
Arsenic	1.0E+01	2.3E-06	3.0E-04	7.8E-03	
Copper	3.8E+02	8.6E-05	4.0E-02	2.1E-03	
Lead	5.7E+03	NA	NA	NA	
			Pathway Total:	3.0E-02	51%
Dermal Contact with Surface Soil					
Antimony	3.5E+01	9.3E-07	8.0E-05	1.2E-02	
Arsenic	1.0E+01	2.7E-07	2.9E-04	9.3E-04	
Copper	3.8E+02	NA	NA	NA	
Lead	5.7E+03	NA	NA	NA	
			Pathway Total:	1.3E-02	21%
Inhalation of Particulates					
Aluminum	7.1E-04	2.3E-05	1.4E-03	1.7E-02	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	NA	NA	NA	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	1.7E-02	28%
			Total RME HI:	5.9E-02	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-34. Summary of Potential Systemic Effects for the Future On-site Adult Resident for SWMU 8 (Bullet Stops)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Antimony	3.5E+01	2.9E-06	4.0E-04	7.2E-03	
Arsenic	1.0E+01	8.5E-07	3.7E-02	2.3E-05	
Copper	3.8E+02	3.1E-05	4.0E-02	7.7E-04	
Lead	5.7E+03	NA	NA	NA	
			Pathway Total:	8.0E-03	1%
Dermal Contact with Surface Soil					
Antimony	3.5E+01	1.4E-07	8.0E-05	1.8E-03	
Arsenic	1.0E+01	4.2E-08	2.9E-04	1.4E-04	
Copper	3.8E+02	NA	NA	NA	
Lead	5.7E+03	NA	NA	NA	
			Pathway Total:	2.0E-03	0%
Inhalation of Particulates					
Aluminum	7.1E-04	2.4E-05	1.4E-03	1.7E-02	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	NA	NA	NA	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	1.7E-02	2%
Ingestion of Leafy Vegetables					
Antimony	4.9E-01	6.9E-05	4.0E-04	1.7E-01	
Arsenic	2.9E-02	4.0E-06	3.0E-04	1.3E-02	
Copper	1.1E+01	1.5E-03	3.7E-02	4.0E-02	
Lead	1.8E+01	NA	NA	NA	
			Pathway Total:	2.3E-01	28%
Ingestion of Tubers and Fruits					
Antimony	2.3E-01	1.1E-04	4.0E-04	2.7E-01	
Arsenic	1.4E-02	6.4E-06	3.0E-04	2.1E-02	
Copper	2.1E+01	9.7E-03	3.7E-02	2.6E-01	
Lead	1.1E+01	NA	NA	NA	
			Pathway Total:	5.6E-01	69%
			Total CTE HI:	8.1E-01	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Antimony	3.5E+01	1.8E-05	4.0E-04	4.6E-02	
Arsenic	1.0E+01	5.3E-06	3.0E-04	1.8E-02	
Copper	3.8E+02	1.9E-04	3.7E-02	5.3E-03	
Lead	5.7E+03	NA	NA	NA	
			Pathway Total:	6.9E-02	2%
Dermal Contact with Surface Soil					
Antimony	3.5E+01	2.1E-06	8.0E-05	2.7E-02	
Arsenic	1.0E+01	6.2E-07	2.9E-04	2.1E-03	
Copper	3.8E+02	NA	NA	NA	
Lead	5.7E+03	NA	NA	NA	
			Pathway Total:	2.9E-02	1%
Inhalation of Particulates					
Aluminum	7.1E-04	3.4E-05	1.4E-03	2.4E-02	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	NA	NA	NA	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	2.4E-02	1%
Ingestion of Leafy Vegetables					
Antimony	4.9E-01	2.4E-04	4.0E-04	6.0E-01	
Arsenic	2.9E-02	1.4E-05	3.0E-04	4.7E-02	
Copper	1.1E+01	5.1E-03	3.7E-02	1.4E-01	
Lead	1.8E+01	NA	NA	NA	
			Pathway Total:	7.9E-01	28%
Ingestion of Tubers and Fruits					
Antimony	2.3E-01	3.8E-04	4.0E-04	9.6E-01	
Arsenic	1.4E-02	2.2E-05	3.0E-04	7.5E-02	
Copper	2.1E+01	3.4E-02	3.7E-02	9.2E-01	
Lead	1.1E+01	NA	NA	NA	
			Pathway Total:	2.0E+00	68%
			Total RME HI:	2.9E+00	100%

aUnits for the inhalation pathway are mg/m^3.
bSee Appendix L for sources and methodology on estimating a daily intake value.
cSee Appendix M for sources and methodology of toxicity values.
dNA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-35. Summary of Potential Systemic Effects for the Future On-site Child Resident for SWMU 8 (Bullet Stops)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Antimony	3.5E+01	1.3E-05	4.0E-04	3.3E-02	
Arsenic	1.0E+01	3.8E-06	3.0E-04	1.3E-02	
Copper	3.8E+02	1.4E-04	3.7E-02	3.8E-03	
Lead	5.7E+03	NA(d)	NA	NA	
			Pathway Total:	4.9E-02	3%
Dermal Contact with Surface Soil					
Antimony	3.5E+01	2.4E-07	8.0E-05	3.0E-03	
Arsenic	1.0E+01	7.1E-08	2.9E-04	2.4E-04	
Copper	3.8E+02	NA	NA	NA	
Lead	5.7E+03	NA	NA	NA	
			Pathway Total:	3.3E-03	0%
Inhalation of Particulates					
Aluminum	7.1E-04	1.2E-04	1.4E-03	8.8E-02	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	NA	NA	NA	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	8.8E-02	6%
Ingestion of Leafy Vegetables					
Antimony	4.9E-01	1.1E-04	4.0E-04	2.8E-01	
Arsenic	2.9E-02	6.5E-06	3.0E-04	2.2E-02	
Copper	1.1E+01	2.4E-03	3.7E-02	6.4E-02	
Lead	1.8E+01	NA	NA	NA	
			Pathway Total:	3.7E-01	26%
Ingestion of Tubers and Fruits					
Antimony	2.3E-01	1.8E-04	4.0E-04	4.4E-01	
Arsenic	1.4E-02	1.0E-05	3.0E-04	3.5E-02	
Copper	2.1E+01	1.6E-02	3.7E-02	4.3E-01	
Lead	1.1E+01	NA	NA	NA	
			Pathway Total:	9.0E-01	64%
			Total CTE HI:	1.4E+00	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Antimony	3.5E+01	6.5E-05	4.0E-04	1.6E-01	
Arsenic	1.0E+01	1.9E-05	3.0E-04	6.4E-02	
Copper	3.8E+02	6.9E-04	3.7E-02	1.9E-02	
Lead	5.7E+03	NA	NA	NA	
			Pathway Total:	2.5E-01	7%
Dermal Contact with Surface Soil					
Antimony	3.5E+01	1.5E-06	8.0E-05	1.9E-02	
Arsenic	1.0E+01	4.3E-07	2.9E-04	1.5E-03	
Copper	3.8E+02	NA	NA	NA	
Lead	5.7E+03	NA	NA	NA	
			Pathway Total:	2.0E-02	1%
Inhalation of Particulates					
Aluminum	7.1E-04	9.0E-05	1.4E-03	6.4E-02	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	NA	NA	NA	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	6.4E-02	2%
Ingestion of Leafy Vegetables					
Antimony	4.9E-01	2.6E-04	4.0E-04	6.6E-01	
Arsenic	2.9E-02	1.5E-05	3.0E-04	5.1E-02	
Copper	1.1E+01	5.6E-03	3.7E-02	1.5E-01	
Lead	1.8E+01	NA	NA	NA	
			Pathway Total:	8.6E-01	26%
Ingestion of Tubers and Fruits					
Antimony	2.3E-01	4.2E-04	4.0E-04	1.0E+00	
Arsenic	1.4E-02	2.4E-05	3.0E-04	8.2E-02	
Copper	2.1E+01	3.7E-02	3.7E-02	1.0E+00	
Lead	1.1E+01	NA	NA	NA	
			Pathway Total:	2.1E+00	64%
			Total RME HI:	3.3E+00	100%

aUnits for the inhalation pathway are mg/m^3.
bSee Appendix L for sources and methodology on estimating a daily intake value.
cSee Appendix M for sources and methodology of toxicity values.
dNA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-36. Summary of Potential Systemic Effects for the Current/Future On-site Laborer for SWMU 8 as a Whole

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Aluminum	1.7E+04	4.2E-05	1.0E+00	4.2E-05	
Antimony	3.2E+01	7.5E-08	4.0E-04	1.9E-04	
Arsenic	8.7E+00	2.1E-08	3.0E-04	6.9E-05	
Copper	5.2E+01	1.2E-07	4.0E-02	3.1E-06	
Lead	5.4E+02	NA(d)	NA	NA	
			Pathway Total:	3.0E-04	32%
Dermal Contact with Surface Soil					
Aluminum	1.7E+04	2.1E-06	2.0E-01	1.0E-05	
Antimony	3.2E+01	3.7E-09	8.0E-05	4.7E-05	
Arsenic	8.7E+00	1.0E-09	2.9E-04	3.5E-06	
Copper	5.2E+01	NA	NA	NA	
Lead	5.4E+02	NA	NA	NA	
			Pathway Total:	6.1E-05	6%
Inhalation of Particulates					
Aluminum	7.1E-04	8.1E-07	1.4E-03	5.8E-04	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	NA	NA	NA	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	5.8E-04	62%
			Total CTE HI:	9.4E-04	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Aluminum	1.7E+04	4.0E-03	1.0E+00	4.0E-03	
Antimony	3.2E+01	7.2E-06	4.0E-04	1.8E-02	
Arsenic	8.7E+00	2.0E-06	3.0E-04	6.6E-03	
Copper	5.2E+01	1.2E-05	4.0E-02	3.0E-04	
Lead	5.4E+02	NA	NA	NA	
			Pathway Total:	2.9E-02	57%
Dermal Contact with Surface Soil					
Aluminum	1.7E+04	4.6E-04	2.0E-01	2.3E-03	
Antimony	3.2E+01	8.3E-07	4.0E-04	2.1E-03	
Arsenic	8.7E+00	2.3E-07	2.9E-04	7.8E-04	
Copper	5.2E+01	NA	NA	NA	
Lead	5.4E+02	NA	NA	NA	
			Pathway Total:	5.2E-03	10%
Inhalation of Particulates					
Aluminum	7.1E-04	2.3E-05	1.4E-03	1.7E-02	
Antimony	1.3E-06	NA	NA	NA	
Arsenic	3.6E-07	NA	NA	NA	
Copper	2.1E-06	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
			Pathway Total:	1.7E-02	33%
			Total RME HI:	5.1E-02	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-37. Summary of Potential Systemic Effects for the Current Off-site Adult Resident for SWMU 8 as a Whole

Chemical	Exposure Point Concentration (mg/m^3)	Daily Noncarcinogenic Intake(a) (mg/kg-day)	Chronic RfD(b) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Inhalation of Particulates					
Aluminum	3.2E-04	1.1E-05	1.4E-03	7.8E-03	
Antimony	5.8E-07	NA(c)	NA	NA	
Arsenic	1.6E-07	NA	NA	NA	
Copper	9.6E-07	NA	NA	NA	
Lead	9.9E-06	NA	NA	NA	
			Total CTE HI:	7.8E-03	100%
Reasonable Maximum Exposure (RME) Scenario					
Inhalation of Particulates					
Aluminum	3.2E-04	1.5E-05	1.4E-03	1.1E-02	
Antimony	5.8E-07	NA	NA	NA	
Arsenic	1.6E-07	NA	NA	NA	
Copper	9.6E-07	NA	NA	NA	
Lead	9.9E-06	NA	NA	NA	
			Total RME HI:	1.1E-02	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.

[b]See Appendix M for sources and methodology of toxicity values.

[c]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-38. Summary of Potential Systemic Effects for the Current Off-site Child Resident for SWMU 8 as a Whole

Chemical	Exposure Point Concentration (mg/m^3)	Daily Noncarcinogenic Intake[(a)] (mg/kg-day)	Chronic RfD[(b)] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Inhalation of Particulates					
Aluminum	3.2E-04	5.6E-05	1.4E-03	4.0E-02	
Antimony	5.8E-07	NA[(c)]	NA	NA	
Arsenic	1.6E-07	NA	NA	NA	
Copper	9.6E-07	NA	NA	NA	
Lead	9.9E-06	NA	NA	NA	
			Total CTE HI:	4.0E-02	100%
Reasonable Maximum Exposure (RME) Scenario					
Inhalation of Particulates					
Aluminum	3.2E-04	4.0E-05	1.4E-03	2.9E-02	
Antimony	5.8E-07	NA	NA	NA	
Arsenic	1.6E-07	NA	NA	NA	
Copper	9.6E-07	NA	NA	NA	
Lead	9.9E-06	NA	NA	NA	
			Total RME HI:	2.9E-02	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.

[b]See Appendix M for sources and methodology of toxicity values.

[c]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-39. Summary of Potential Systemic Effects for the Current Adult Beef Consumer of Cattle from Grazing Allotment 2 (SWMU 8)

Chemical	Exposure Point Concentration (mg/kg)	Daily Noncarcinogenic Intake[(a)] (mg/kg-day)	Chronic RfD[(b)] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Beef					
Aluminum	6.3E-02	1.5E-05	1.0E+00	1.5E-05	
Antimony	1.2E-04	2.9E-08	4.0E-04	7.1E-05	
Arsenic	3.0E-05	7.3E-09	3.0E-04	2.4E-05	
Copper	2.7E-03	6.5E-07	3.7E-02	1.7E-05	
Lead	9.7E-05	NA[(c)]	NA	NA	
			Total CTE HI:	1.3E-04	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Beef					
Aluminum	6.3E-02	6.3E-05	1.0E+00	6.3E-05	
Antimony	1.2E-04	1.2E-07	4.0E-04	2.9E-04	
Arsenic	3.0E-05	3.0E-08	3.0E-04	1.0E-04	
Copper	2.7E-03	2.7E-06	3.7E-02	7.2E-05	
Lead	9.7E-05	NA	NA	NA	
			Total RME HI:	5.3E-04	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.

[b]See Appendix M for sources and methodology of toxicity values.

[c]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-40. Summary of Potential Systemic Effects for the Child Beef Consumer of Cattle for Grazing Allotment 2 (SWMU 8)

Chemical	Exposure Point Concentration (mg/kg)	Daily Noncarcinogenic Intake[a] (mg/kg-day)	Chronic RfD[b] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Beef					
Aluminum	6.3E-02	3.4E-05	1.0E+00	3.4E-05	
Antimony	1.2E-04	6.3E-08	4.0E-04	1.6E-04	
Arsenic	3.0E-05	1.6E-08	3.0E-04	5.4E-05	
Copper	2.7E-03	1.4E-06	3.7E-02	3.9E-05	
Lead	9.7E-05	NA[c]	NA	NA	
			Total CTE HI:	2.9E-04	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Beef					
Aluminum	6.3E-02	9.7E-05	1.0E+00	9.7E-05	
Antimony	1.2E-04	1.8E-07	4.0E-04	4.5E-04	
Arsenic	3.0E-05	4.6E-08	3.0E-04	1.5E-04	
Copper	2.7E-03	4.1E-06	3.7E-02	1.1E-04	
Lead	9.7E-05	NA	NA	NA	
			Total RME HI:	8.1E-04	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.

[b]See Appendix M for sources and methodology of toxicity values.

[c]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

6.1.4.5.1 ***Characterization of Potential Carcinogenic Risks.*** The USEPA currently classifies lead salts as probable human carcinogens (Class B2). However, quantifying lead's cancer risk involves many uncertainties, some of which may be unique to lead. Age, health, nutritional state, body burden, and exposure duration influence the absorption, release, and excretion of lead. In addition, current knowledge of lead pharmacokinetics indicates that an estimate derived by standard procedures would not truly describe the potential risk. Thus, the USEPA's Carcinogen Assessment Group recommends that a numerical estimate not be used (USEPA 1995a).

Firing Lines. The general process used to select the COPCs associated with the Firing Line area of concern is described in Section 3.1.1. COPC selection for SWMU 8 is described in Section 6.1.4.2. For future land use scenarios, chromium, a confirmed human carcinogen, is the only COPC identified. Table 6-10 lists the COPCs and their associated media.

Future Construction Worker. The cumulative ILCR from potential exposure to arsenic for all pathways are 6.8E-06 and 5.2E-07 for the RME and CTE scenarios, respectively. As summarized in Table 6-17, the only pathway evaluated is inhalation of particulates generated from subsurface soil. Chromium is the sole contributor to this risk estimate.

Drainage Area of Concern. The general process used to select the COPCs associated with the Drainage area of concern is described in Section 3.1.4.1. COPC selection for SWMU 8 is described in Section 6.1.4.2. For current and future land use scenarios, aluminum, antimony, arsenic, copper, and lead were identified as COPCs. Arsenic, a known human carcinogen, is the only COPC that contributes to the carcinogenic risk. Tables 6-11 and 6-12 list the COPCs and their associated media.

Current/Future On-site Laborer. The cumulative ILCR for all pathways is 5.9 E-08 and 2.4 E-10 for the RME and CTE scenarios, respectively. As summarized in Table 6-18, the only pathway evaluated is inhalation of particulates. Oral carcinogenic toxicity information is not currently available for aluminum; therefore, the ingestion of and dermal contact with surface soil pathways were not quantitatively evaluated.

Future On-site Adult Resident. The cumulative ILCR for all pathways is 1.0E-07 and 1.9E-08 for the RME and CTE scenarios, respectively. As summarized in Table 6-19, the only pathway evaluated is inhalation of particulates. Oral carcinogenic toxicity information is not currently available for aluminum; therefore, the ingestion of and dermal contact with surface soil pathways were not quantitatively evaluated.

Future On-site Child Resident. The cumulative ILCR for all pathways is 1.6E-07 and 9.9E-08 for the RME and CTE scenarios, respectively. As summarized in Table 6-20, the only pathway evaluated is inhalation of particulates. Oral carcinogenic toxicity information is not currently available for aluminum; therefore, the ingestion of and dermal contact with surface soil pathways were not quantitatively evaluated.

Bullet Stop Area of Concern. The general process used to select the COPCs associated with the Bullet Stop area of concern is described in Section 3.1.4.1. COPC selection for SWMU 8

is described in Section 6.1.4.2. For current and future land use scenarios, aluminum, antimony, arsenic, copper, and lead were identified as COPCs. Arsenic, a known human carcinogen, is the only COPC that contributes to the carcinogenic risk. Tables 6-13 and 6-14 list the COPCs and their associated media.

Current On-site Laborer. The cumulative ILCR for all pathways is 1.4E-06 and 1.8E-09 for the RME and CTE scenarios, respectively. As summarized in Table 6-21, the driving pathway is ingestion of surface soil, which contributes greater than 82 percent of the estimated risk.

Total ILCR for incidental ingestion of surface soil by laborers is 1.2E-06 and 1.5E-09 for the RME and CTE scenarios, respectively. Dermal contact with surface soil and inhalation of particulates by laborers do not present an individual risk above the lower bound of the target risk range. The estimated ILCRs for these pathways range from 1.4E-07 to 7.5E-11. Arsenic is the only contributor to the estimated risks.

Future On-site Adult Resident. The cumulative ILCR for all pathways is 2.6E-05 and 1.8E-06 for the RME and CTE scenarios, respectively. As summarized in Table 6-22, the driving pathway is ingestion of produce, which contributes greater than 85 percent of the estimated risk.

Incremental lifetime cancer risk attributed to ingestion of produce, such as homegrown vegetables by adults, results in an estimated ILCR of 2.2E-05 and 1.6E-06 using RME and CTE parameters, respectively. Ingestion of surface soil by adults during yard work, gardening, etc., results in an estimated ILCR of 3.2E-06 using RME conditions and 1.4E-07 using the CTE conditions. The ILCRs for the remaining pathways evaluated—dermal contact with surface soil and inhalation of particulates—are below the target risk range for both the RME and CTE scenarios, and range from 3.8E-07 to 6.9E-09. Arsenic is the sole contributor to this risk estimate.

Future On-site Child Resident. The cumulative ILCR for all pathways is 2.2E-05 and 3.4E-06 for the RME and CTE scenarios, respectively. As summarized in Table 6-23, the driving pathway is ingestion of produce, which contributes greater than 67 percent of the estimated risk.

Incremental lifetime cancer risk attributed to ingestion of produce , such as homegrown vegetables by children, results in an estimated ILCR of 1.4E-05 and 2.7E-06 using RME and CTE parameters, respectively. Ingestion of surface soil by children during yard work, playing, etc., results in an estimated ILCR of 6.8E-06 using RME conditions and 6.1E-07 using the CTE conditions. The ILCRs for the remaining pathways evaluated—dermal contact with surface soil and inhalation of particulates—are below the target risk range for both the RME and CTE scenarios, and range from 1.6E-07 to 1.2E-08. Arsenic is the sole contributor to this risk estimate.

<u>SWMU 8 As a Whole</u>. The general process used to select the COPCs associated with SWMU 8 as a whole is described in Section 3.1.4.1. COPC selection for SWMU 8 is described in Section 6.1.4.2. For current land use scenarios, aluminum, antimony, arsenic, copper, and

lead were identified as COPCs. Arsenic, a known human carcinogen, is the only COPC that contributes to the carcinogenic risk. Table 6-15 lists the COPC and their associated media.

Current/Future On-site Laborer. The cumulative ILCR for all pathways is 1.2E-06 and 1.5E-09 for the RME and CTE scenarios, respectively. As summarized in Table 6-24, the driving pathway is ingestion of surface soil, which contributes greater than 80 percent of the estimated risk.

Total ILCR for incidental ingestion of surface soil by laborers is 9.9E-07 and 1.2E-09 for the RME and CTE scenarios, respectively. Dermal contact with surface soil and inhalation of particulates by laborers do not present an individual risk above the lower bound of the target risk range. The estimated ILCRs for these pathways range from 1.2E-07 to 6.3E-11. Arsenic is the only contributor to the estimated risks.

Current Off-site Adult Resident. The cumulative ILCR for inhalation of particulates by the current off-site adult resident does not exceed the lower limit of the target risk range. The cumulative ILCR is 4.6E-08 and 8.7E-09 under the RME and CTE scenarios, respectively, as summarized in Table 6-25.

Current Off-site Child Resident. The cumulative ILCR for inhalation of particulates by the current off-site child resident does not exceed the lower limit of the target risk range. The cumulative ILCR is 7.2E-08 and 4.5E-08 under the RME and CTE scenarios, respectively, as summarized in Table 6-26.

Current Adult Beef Consumer. The ILCR for ingestion of beef associated with SWMU 8 grazing allotment by the adult residents in the surrounding communities is 1.8E-08 and 1.2E-09 under the RME and CTE scenarios, respectively, as summarized in Table 6-27.

Current Child Beef Consumer. The ILCR for ingestion of beef associated with SWMU 8 grazing allotment by the child residents in the surrounding communities is 1.7E-08 and 2.6E-09 under the RME and CTE scenarios, respectively, as summarized in Table 6-28.

6.1.4.5.2 *Characterization of Potential Systemic Effects*

<u>Firing Lines Area of Concern.</u> The general process used to select the COPCs associated with the Firing Line area of concern is described in Section 3.1.4.1. COPC selection for SWMU 8 is described in Section 6.1.4.2. For future land use scenarios, chromium is the only identified COPC. Table 6-10 lists the COPC and its associated media.

Future Construction Worker. As summarized in Table 6-29, the summed HI for all pathways does not exceed unity and ranges from 7.0E-03 to 1.2E-03 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of subsurface soil which contributes greater than 74 percent of the total HI. The sole contributor to these risk estimates is chromium.

Drainage Area of Concern. The general process used to select the COPCs associated with the Drainage area of concern is described in Section 3.1.4.1. COPC selection for SWMU 8 is described in Section 6.1.4.2. For current and future land use scenarios, aluminum, antimony, arsenic, copper, and lead were identified as COPCs. Potential systemic effects were only evaluated for aluminum. Noncarcinogenic toxicity information is not currently available for the remaining COPCs. Tables 6-11 and 6-12 provide a listing of the COPCs and their associated media.

Current/Future On-site Laborers. As summarized in Table 6-30, the summed HI for all pathways does not exceed unity and ranges from 1.7E-02 to 6.4E-04 for the RME and CTE scenarios, respectively. The driving pathway is inhalation of particulates, which contributes greater than 90 percent of the total HI. The sole contributor to these risk estimates is aluminum.

Future On-site Adult Resident. As summarized in Table 6-31, the summed HI for all pathways does not exceed unity and ranges from 4.9E-02 to 2.2E-02 for the RME and CTE scenarios, respectively. The driving pathway is inhalation of particulates, which contributes greater than 50 percent of the total HI. The sole contributor to these risk estimates is aluminum.

Future On-site Child Resident. As summarized in Table 6-32, the summed HI for all pathways does not exceed unity and ranges from 1.1E-01 to 1.0E-01 for the RME and CTE scenarios, respectively. The driving pathway is inhalation of particulates, which contributes greater than 56 percent of the total HI. The sole contributor to these risk estimates is aluminum.

Bullet Stop Area of Concern. The general process used to select the COPCs associated with the Bullet Stop area of concern is described in Section 3.1.4.1. COPC selection for SWMU 8 is described in Section 6.1.4.2. For current and future land use scenarios, aluminum, antimony, arsenic, copper, and lead were identified as COPCs. Potential systemic effects were evaluated for all COPCs with the exception of lead. Tables 6-14 and 6-15 provide a listing of the COPCs and their associated media.

Current/Future On-site Laborers. As summarized in Table 6-33, the summed HI for all pathways does not exceed unity and ranges from 5.9E-02 to 9.5E-04 for the RME and CTE scenarios, respectively. The driving pathway for the RME scenario is ingestion of surface soil, 51 percent, and inhalation of particulates, 61 percent, for the CTE scenario. The major contributor to these risk estimates is aluminum.

Future On-site Adult Resident. As summarized in Table 6-34, the summed HI for all pathways ranges from 2.9E+00 to 8.1E-01 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of produce, which contributes greater than 96 percent of the total HI.

The total HI for ingestion of produce by adult residents is 2.8E+00 and 7.9E-01 for the RME and CTE scenarios, respectively. The HIs for the remaining pathways evaluated are below unity and range from 6.9E-02 to 2.0E-03.

Future On-site Child Resident. As summarized in Table 6-35, the summed HI for all pathways ranges from 3.3E+00 to 1.4E+00 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of produce, which contributes 90 percent of the total HI.

The total HI for ingestion of produce by child residents is 3.0E+00 and 1.3E+00 for the RME and CTE scenarios, respectively. The HIs for the remaining pathways evaluated are below unity and range from 2.5E-01 to 3.3E-03.

SWMU 8 As a Whole. The general process used to select the COPCs associated with SWMU 8 as a whole is described in Section 3.1.4.1. COPC selection for SWMU 6 is described in Section 6.1.4.2. For current land use scenarios, aluminum, antimony, arsenic, copper, and lead were identified as COPCs. Potential systemic effects were evaluated for all COPCs with the exception of lead. Table 6-16 provides a listing of the COPCs and their associated media.

Current/Future On-site Laborer. As summarized in Table 6-36, the summed HI for all pathways does not exceed unity and ranges from 5.1E-02 to 9.4E-04 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of surface soil, 57 percent, for the RME scenario, and inhalation of particulates, 62 percent, for the CTE scenario. The major contributor to the risk estimates is aluminum.

Current Off-site Adult Resident. As summarized in Table 6-37, the HI for the inhalation of particulates pathway does not exceed unity. The total HIs for the inhalation pathway ranges from 1.1E-02 to 7.8E-03 for the RME and CTE scenarios, respectively.

Current Off-site Child Resident. As summarized in Table 6-38, the HI for the inhalation of particulates pathway does not exceed unity. The total HIs for the inhalation pathway ranges from 2.9E-02 to 4.0E-02 for the RME and CTE scenarios, respectively.

Current Adult Beef Consumer. As summarized in Table 6-39, the HI for the ingestion of beef pathway does not exceed unity. The total HIs for the inhalation pathway ranges from 5.3E-04 to 1.3E-04 for the RME and CTE scenarios, respectively.

Current Child Beef Consumer. As summarized in Table 6-40, the HI for the ingestion of beef pathway does not exceed unity. The total HIs for the inhalation pathway ranges from 8.1E-04 to 2.9E-04 for the RME and CTE scenarios, respectively.

6.1.4.5.3 *Characterization of Hazards Associated with Exposures to Lead*

Current Off-site Child Residents. The USEPA has developed the IEUBK model to evaluate lead exposure in children. The model estimates blood lead levels resulting from all applicable

routes of exposure. The agency has set a target blood lead level of 10 μg Pb/dL blood. The IEUBK model was run for potential off-site residential exposures to resuspended lead-containing particulate. All defaults in the model were maintained except the input air concentration. This input value was the boundary line concentration resulting from the air dispersion modeling (Appendix N). Predicted mean blood lead levels ranged from 4.5 μg Pb/dL blood for children aged 1 to 2 years down to 2.7 μg Pb/dL blood for children aged 6 to 7 years. Mean blood lead level for the age span 0 to 7 years was 3.7 μg Pb/dL blood, which is below the USEPA target blood level of 10 μg/g pb/dL blood.

Future On-site Child Residents. The IEUBK model was run for potential future on-site residential exposures to lead in soil, produce, air, and drinking water. All defaults in the model were maintained except the input air, soil, and produce concentrations and the parameters: time spent outdoors, 3 hours/day, and lung absorption rate, 50 percent (see Appendix L). The input air value is the boundary line concentration resulting from the air dispersion modeling (Appendix N). Lead concentrations in soil and produce are based on an average EPC for lead. Predicted mean blood lead levels ranged from 25.2 μg Pb/dL blood for children aged 1 to 2 years down to 16.5 μg Pb/dL blood for children aged 6 to 7 years. Mean blood lead level for the age span 0 to 7 years is 21.5 μg Pb/dL blood, which is above the USEPA target blood lead level of 10 μg Pb/dL blood. Soil and dust uptake is the driving pathway, contributing greater than 90 percent of the total blood lead level.

Occupational Experience. The agency recognizes that this approach is not appropriate for land use best described by non-residential adult exposure (USEPA 1994d). The agency has recommended a short-term option based on a simple approach that approximates the more complicated biokinetics in humans. Models for adult exposure are available in the scientific literature and meet USEPA's short-term criterion. Exposures and acceptable residual soil levels were estimated using the model developed by Bowers and colleagues (1994) as modified by USEPA Region VIII in the risk assessment for the California Gulch Superfund site (USEPA 1995b) (see Appendix O). A target blood lead level range of 11.1 μg Pb/dL blood was used in the evaluation to account for women of child-bearing age in the work force (USEPA 1995b).

For the on-site laborer, two exposure settings were used to estimate the blood lead levels for the CTE and RME exposure scenarios–Bullet Stop Area of concern and SWMU 8 as a whole. In addition, the potential future construction worker scenario was evaluated for the Bullet Stop Area of concern. For both the RME and CTE scenarios, the blood lead levels for the on-site laborer (CTE—2.23 to 2.20 μgPb/dL; RME—2.43 to 4.68 μgPb/dL) and construction worker (CTE—2.40 μgPb/dL; RME—3.17 μgPb/dL) are below the USEPA's target blood level of 11.1 μg Pb/dL blood.

SWMU 8 is part of Grazing Allotment 3 at TEAD-N. Uptake of lead into beef muscle tissue was modeled using the transfer factor from feed to muscle proposed by Stevens (1992). This is almost certainly an overestimate because lead is considered to bioconcentrate in offal and bone. Nonetheless, the modeled concentration in muscle is at least an order of magnitude below the value of 0.02 μg/g cited by USEPA (1986c). No specific ingestion rates were

available for offal in the western U.S., but it is estimated that consumption of organ meats comprises less than 0.5 percent of the total meat ingested (USDA 1993).

6.1.4.6 *Risk Assessment Summary and Conclusions*

An RA was conducted for the Small Arms Firing Range (SWMU 8) based on Phase II RI data. Several current- and future-use scenarios were quantitatively evaluated:

- On-site laborer/security worker
- Off-site resident (inhalation only)
- On-site residents (redevelopment)
- Construction worker (during redevelopment)
- Consumers of beef grazed on the grazing allotment containing SWMU 8

A summary of RME risk results for SWMU 8 is shown in Figure 6-41 and of CTE risk results in Table 6-42.

For the current/future on-site laborer/security worker, all scenarios were found to fall within or below the target risk range of 10^{-4} to 10^{-6} for the ILCR and unity (one) for the total HI.

ILCRs for both adult and child off-site residents were well below the lower limits of the target risk range of 10^{-6} for the ILCR and unity (one) for the HI. The same is also true for the current adult and child beef consumer.

ILCRs for both future on-site adult and child residents are within or below the target risk range of 10^{-4} to 10^{-6} for carcinogenic risk. The HIs are below unity (one) for both the adult and child residents with the exception of the Bullet Stop Area of concern. For the adult and child RME and CTE scenarios for this area of concern, the HI ranges from 2.9E+00 to 8.2E-01 and 3.3E+00 to 1.4E+00, respectively. The ingestion of produce pathway is the major contributor to the risk results.

Food-chain pathways (i.e., home gardening) are significant contributors to total risks. According to Lee Sherry, a home economist with the Utah State University Agricultural Extension Service in Tooele, saline content in area soils generally require home gardeners and landscapers to replace or augment the existing soil with new topsoil. The above observation is confirmed by soil testing results from the Utah State University Soil Testing Laboratory (Appendix G).

Models used to estimate uptake into edible portions of plants have been shown to overestimate that uptake. For example, in the United Kingdom, studies of crops grown in soils near mining operations that are heavily contaminated with arsenic do not show appreciable arsenic uptake. In Poland, vegetables grown in high arsenic containing soils near power stations, superphosphate plants, and smelters all measure less than 0.2 μg/g wet weight (O'Neill 1990).

Table 6-41. Summary of RME Risk Results for SWMU 8

Scenario	Firing Lines			Drainage Area		Bullet Stop Area			SWMU as a Whole		
	HI	ILCR	Blood Lead Levels (µg Pb/dL Blood)	HI	ILCR	HI	ILCR	Blood Lead Levels (µg Pb/dL Blood)	HI	ILCR	Blood Lead Levels (µg Pb/dL Blood)
Current Land Use											
On-site Laborer	---[a]	---	---	1.7E-02	5.9E-08	5.9E-02	1.4E-06	4.68	5.1E-02	1.2E-06	2.43
Off-site Adult Resident	---	---	---	---	---	---	---	---	1.1E-02	4.6E-08	---[b]
Off-site Child Resident	---	---	---	---	---	---	---	---	2.9E-02	7.2E-08	3.70
Adult Beef Consumer	---	---	---	---	---	---	---	---	5.3E-04	1.8E-08	---
Child Beef Consumer	---	---	---	---	---	---	---	---	8.1E-04	1.7E-08	---
Future Land Use											
On-site Adult Resident	---	---	---	4.9E-02	1.0E-07	2.9E+00	2.6E-05	---[b]	---	---	---
On-site Child Resident	---	---	---	1.1E-01	1.6E-07	3.3E+00	2.2E-05	21.50	---	---	---
Construction Worker	7.0E-03	6.8E-06	3.17	---	---	---	---	---	---	---	---

[a]Not evaluated.
[b]Per EPA Guidance, the IEUBK model is designed for the child receptor, who is the most sensitive receptor. Therefore, blood lead levels for the adult receptor were not quantified.

6-42. Summary of CTE Risk Results for SWMU 8

Scenario	Firing Lines			Drainage Area		Bullet Stop Area			SWMU as a Whole		
	HI	ILCR	Blood Lead Levels (µg Pb/dL Blood)	HI	ILCR	HI	ILCR	Blood Lead Levels (µg Pb/dL Blood)	HI	ILCR	Blood Lead Levels (µg Pb/dL Blood)
Current Land Use											
On-site Laborer	---[a]	---	---	6.4E-04	2.4E-10	9.5E-04	1.8E-09	2.23	9.4E-04	1.5E-09	2.20
Off-site Adult Resident	---	---	---	---	---	---	---	---	7.8E-03	8.7E-09	---[b]
Off-site Child Resident	---	---	---	---	---	---	---	---	4.0E-02	4.5E-08	3.70
Adult Beef Consumer	---	---	---	---	---	---	---	---	1.3E-04	1.2E-09	---
Child Beef Consumer	---	---	---	---	---	---	---	---	2.9E-04	2.6E-09	---
Future Land Use											
On-site Adult Resident	---	---	---	2.2E-02	1.9E-08	8.1E-01	1.8E-06	---[b]	---	---	---
On-site Child Resident	---	---	---	1.0E-01	9.9E-08	1.4E+00	3.4E-06	21.50	---	---	---
Construction Worker	1.2E-03	5.2E-07	2.40	---	---	---	---	---	---	---	---

[a]Not evaluated.
[b]Per EPA Guidance, the IEUBK model is designed for the child receptor, who is the most sensitive receptor. Therefore, blood lead levels for the adult receptor were not quantified.

This is an order of magnitude less than that predicted by the models used in this risk assessment employing the transfer coefficients developed by Baes and coworkers (1984).

For the future construction worker, all scenarios were found to fall within or below the target risk range of 10^{-4} to 10^{-6} for the ILCR and unity (one) for the total HI.

Due to a lack verified toxicity data for lead, potential systemic effects for that metal were quantitatively evaluated based on EPA's Integrated Exposure Uptake Biokinetic Model (USEPA 1994) for lead in children. The model estimates blood lead levels resulting from all applicable routes of exposure. The agency has set a target blood lead level of 10 μg Pb/dL blood. For the inhalation of particulates pathway for the current off-site child resident, a mean blood lead level of 3.7 μg Pb/dL for the age span 0 to 7 years was estimated, which is below the USEPA target blood lead level of 10 μg Pb/dL blood. Predicted mean blood lead levels for the hypothetical on-site child resident ranged from 25.2 μg Pb/dL blood for children aged 1 to 2 years down to 16.5 μg Pb/dL blood for children aged 6 to 7 years. Mean blood lead level for the age span 0 to 7 years is 21.5 μg Pb/dL blood, which is above the USEPA target blood lead level of 10 μg Pb/dL blood. Dietary uptake is the driving pathway, contributing greater than 90 percent of the total blood lead level.

Uptake of lead into beef muscle tissue was estimated to be at least two orders of magnitude below the value of 0.02 μg/g cited by USEPA (1986c) as a background level. No specific ingestion rates were available for offal in the western U.S., but it is estimated that consumption of organ meats comprises less than 0.5 percent of the total meat ingested (USDA 1993).

For the on-site laborer, two exposure settings were used to estimate the blood lead levels for the CTE and RME exposure scenarios—Bullet Stop area of concern and SWMU 8 as a whole. In addition, the potential future construction worker scenario was evaluated for the Bullet Stop Area of concern. For both the RME and CTE scenarios, the blood lead levels for the on-site laborer and construction worker are below the USEPA's target blood level of 11.1 μg Pb/dL blood. Given that there is currently no full-time work force at SWMU 8 and that SWMU 8 is not part of the BRAC parcel, thus warranting reconstruction, no remediation appears warranted based on human exposure to lead.

When site-specific conditions are considered along with the conservative assumptions designed to offset assessment uncertainties, the risk estimates for the future residential scenario are, in point of fact, likely to be overestimates, at a minimum. Under the current BRAC, SWMU 8 is not included in the parcel for potential release for private redevelopment. In fact, the mission of SWMU 8 is assumed to continue into the indefinite future. Based on the available analytical data and the above considerations, the risk assessment results indicate that there is no immediate and substantial danger to human health from the presence of low levels of hazardous chemicals at SWMU 8.

6.1.5 Conclusions and Recommendations

During the summer of 1994, the Small Arms Firing Range (SWMU 8) Phase II RI field investigation was conducted to further characterize the nature and extent of metals contamination detected during the Phase I investigation. The Phase II sampling effort consisted of both surface and subsurface soil sampling for metals. Metals detected at concentrations exceeding their respective background values were antimony, arsenic, barium, chromium, cobalt, copper, lead, mercury, nickel, selenium, silver, vanadium, and zinc.

A baseline human health risk assessment was conducted at this SWMU to determine any potential human health risks associated with a no-action alternative. COPCs were evaluated in both surface and subsurface soil for four areas of concern. Antimony, arsenic, copper, and lead in surface soil and lead in subsurface soil were the COPCs retained for further evaluation based on the USEPA soil screening criteria in the Bullet Stop area of concern. Only chromium in subsurface soil was retained for the Firing Lines area of concern. No COPCs were retained between the firing lines, and only aluminum was retained for the drainage area behind the bullet stops. The RME and CTE were evaluated for several current and future use scenarios and resulted in risk estimates falling within or below the target ranges for tolerable ICLRs and HIs except for future on-site residents in the Bullet Stop area where HI exceeded unity (one). Lead was evaluated separately based on agency guidance. Estimated blood lead levels were found to be acceptable for all scenarios with the exception of the future on-site child resident where blood lead levels ranged from 16.5 to 25.5 μg Pb/dL compared to the target level of 10 μg Pb/dL. It is important to note that additional soil sampling for antimony and thallium may be necessary prior to releasing the land for future residential use. This information will be carried forward through the FS and ROD process.

These human health risk assessment results indicate that cleanup of the bullet stops would effectively reduce human health risks to within acceptable levels at SWMU 8. Future cleanup options will be based on industrial cleanup levels established for each metal by Dames and Moore during the planning phase of the FS. Results of the ecological risk assessment are presented in the TEAD SWERA (Rust E&I 1996). It is recommended that no further remedial investigations are necessary. An FS will be conducted for SWMU 8, as required by CERCLA, to determine what remedies are required for this site. Removal of the bullet stops will be assessed as part of the FS process. Conclusions from this report and the SWERA will be used during the FS process to derive final recommendations for SWMU 8.

6.2 AED TEST RANGE (SWMU 40)

6.2.1 Site Characteristics

The AED Test Range (see Figure 1-2) is located in the northwestern portion of TEAD and has been used extensively for the testing of munitions, bombs, and rocket engines. This SWMU consists of several bermed revetments, a drop tower, a deactivation furnace (only the building foundation remains), and an observation bunker. Testing ranged from detonation of 1-ton bombs to small munitions and also included the testing of rocket engines. The area contains both spent materials and UXO. The former deactivation furnace building was used to test the conveyor spacing for the deactivation furnace. The furnace and building were damaged as a result of explosions that took place during the testing. Fragments of propellant for rocket engines were also observed in the revetment surrounding the drop tower. One area located in the northern portion of the test range was used for the detonation of 1-ton bombs as evidenced by over 20 bomb craters. Testing in the AED Test Range was largely conducted by personnel observing the test from an observation bunker on a hill to the southeast of the testing revetments. SWMU 40 appears to have been used extensively as indicated by the UXO, metal debris from spent munitions, and rocket propellant scattered across the SWMU. It is important to note that the surveys conducted at SWMU 40 may not have completely identified 100 percent of the UXO and propellant at this SWMU. The area was used occasionally for testing until September 1995 when the AED closed the SWMU to further testing.

6.2.2 Previous Investigations and Phase I and Phase II RI Activities

No previous environmental investigations had been conducted at the AED Test Range prior to the Phase I RI field activities. The area appears to have been used extensively over the years for all types of munitions testing. Because of the presence of UXO (several projectiles were found during the site visits and Phase I and Phase II field activities), Rust E&I utilized EOD Technologies, Inc. (EODT) to conduct a UXO sweep of areas to be characterized as part of the current RI. Following the UXO sweeps, Phase I RI field investigation activities at the AED Test Range consisted of (1) geophysical surveying to determine if buried metal wastes were present in the revetments, (2) surface soil sampling around the building foundation and the floor of the revetments, and (3) sampling of test pits for the characterization of any subsurface materials identified by the geophysical surveys.

During Phase I, geophysical surveys using magnetometry were conducted over the entire floor area of six of the eight major revetments where evidence of previous testing activities was present during Phase I. Results of these surveys showed possible buried pits or trenches containing metal debris in four of the revetments. Test pits were excavated in the revetments with geophysical anomalies. The locations of the four test pits and seven surface soil sample locations are shown in Figure 6-9. All samples were analyzed for SVOCs, metals, anions, and explosives. Measurements with a PID showed no evidence of VOCs in materials sampled; therefore, no samples for VOCs were necessary. The four test pits were excavated to various depths depending on the buried material present (deepest was 10 feet) with samples collected at the surface (0 to 0.5 foot), from the zone of buried debris (where present), and at the deepest

depth of the test pit. A test pit in one revetment contained abundant munitions debris, the top of a 55-gallon drum, and a heavy metal casing. Samples from this test pit contained elevated concentrations of explosives and metals. Buried materials and subsurface contamination were not encountered in the remaining three test pits completed at the site. The Phase I investigation found that the contamination present was primarily concentrated in the shallow zone (0 to 2.7 feet deep).

The seven surface-soil sample locations from Phase I were located at each of the revetments where test pits were not excavated and also surrounding the building foundation. Several of the surface soil samples contained detectable concentrations of explosives and elevated metals, but the extent of contamination was not determined. One surface soil sample in the revetment containing the drop tower was biased (within 1 foot) toward an unidentified pile of yellow and green materials that appear to be related to explosives or propellants. Large fragments of reddish-brown rocket propellant were also observed on the ground surface.

The originally proposed Phase I field activities included the characterization of a trench in the northwestern portion of the site. During the site visit by Rust E&I in October 1991, the trench, which is still open, was visually inspected and no evidence of waste disposal was observed. Therefore, no further investigation of the trench appeared to be warranted.

In the summer of 1994, Phase II RI field activities were performed at SWMU 40. Because of the variety of testing activities conducted at this site, it was suspected that contaminants for each test area may be different. To further delineate the types and extent of contamination at SWMU 40, additional Phase II surface- and subsurface-soil samples for metals and explosives analysis were needed. A total of 60 test pits were excavated to a depth of 5 feet over the site to define vertical and horizontal extent of contamination (Figure 6-10). Soil samples from each test pit were collected at depths of 0 to 6 inches, 3 feet, and 5 feet. All of the soil samples were analyzed for explosives and metals. Also, UXO surveys were performed prior to the start of any work on the AED Test Range and during all test pit excavation activities. Most of the test pits were concentrated in areas of possible impact from explosives testing (Figure 6-10). In addition, test pits were excavated around the perimeter of SWMU 40 to define the outer limits of contamination at this SWMU.

Many of the test pit locations within the bermed revetments or impact areas were beneath piles of debris, including sand-filled ammunition boxes, concrete blocks, steel plate and piping, shell casings, spent and burned munitions, and chemical simulator land mines. Several test pits were located within the shallow craters produced by detonation of 1-ton bombs as well as in the trench to the south of these craters. During the excavation of test pit ARP-94-25 (Figure 6-10), located in the northeast end of the trench, debris—including canvas material (from an old army tent), a 55-gallon drum, 2-inch PVC pipe, rings from a fiber drum, shipping plugs from mines and bombs, as well as several wooden logs and boxes—was uncovered. This miscellaneous debris was observed from just below the surface to a depth of 7 feet. One test pit, ARP-94-44 (Figure 6-10), was excavated in an incineration trench east of the site access road which consisted of two parallel, east-west trending 25-by-150-foot trenches covered by metal plates with pipes at the western end used to vent smoke from the trenches.

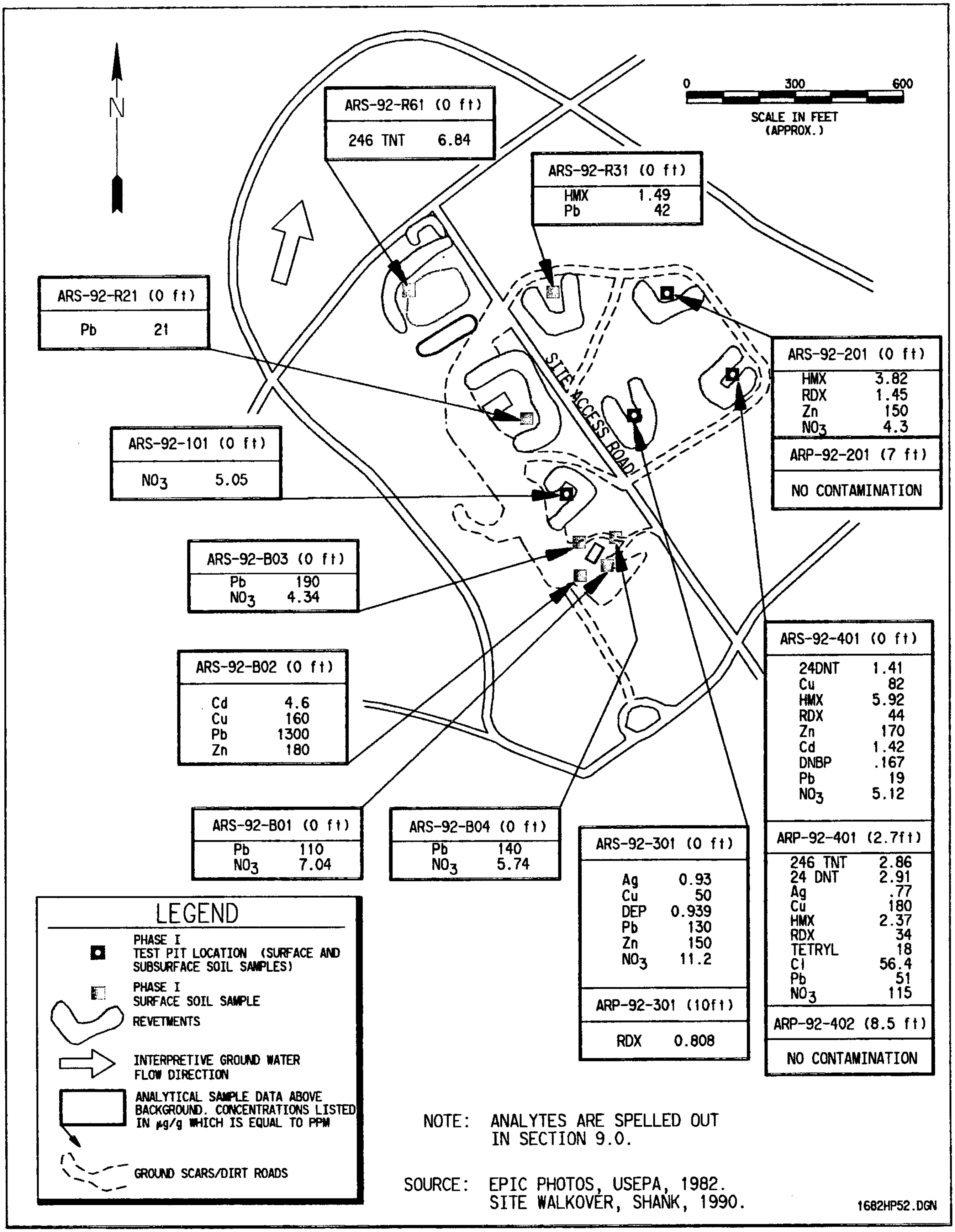

Figure 6-9. SWMU 40 Phase I Sample Locations and Results

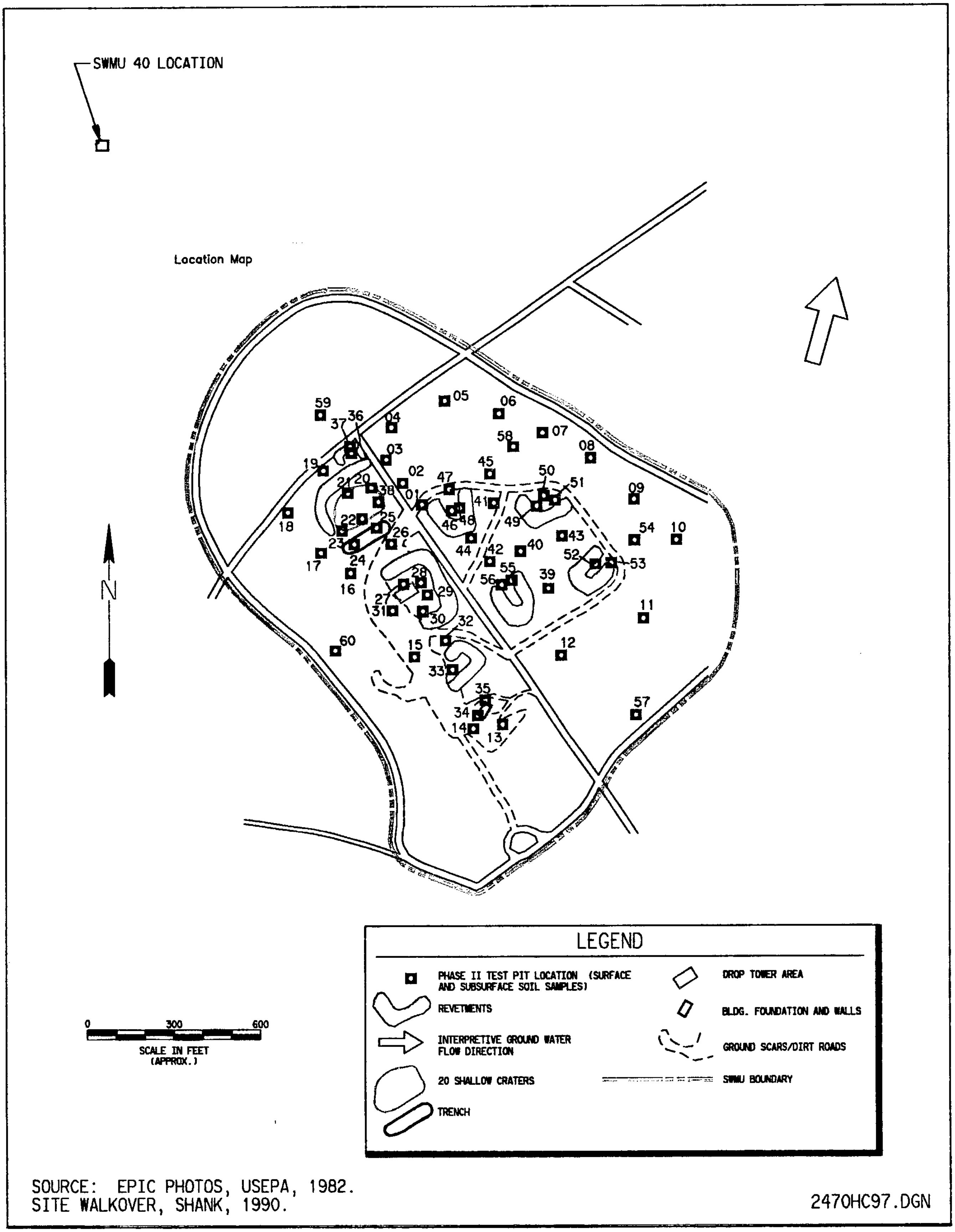

Figure 6-10. SWMU 40 Phase II Test Pit Sample Locations

These trenches were supposedly used to burn smoke grenades; however, 105-mm projectiles (one of them was live), which were wired together as if to be detonated, were found buried 1 foot beneath the bottom of the southern trench. Live time fuses were found at two depths (just below the surface and 3 feet) in Test Pit ARP-94-52. Stringing such projectiles together, covering them in the trenches with steel plates, and detonating them was a common method for munitions destruction. EODT also located several other UXO scattered over the entire SWMU. All UXO located by EODT were disposed of by army personnel.

Due to previous observations of UXO and propellant at SWMU 40, it was determined that the types and extent of these types of potential hazards to human health and the environment should be documented to aid in future remedial-action decisions for the area. To document the extent of UXO, debris, and propellant, the entire SWMU 40 area was gridded (Figure 6-11) in November 1995 and a walking survey was conducted along each grid line. All observed materials were documented on individual grid maps (Appendix Q). All UXO encountered were flagged for proper destruction or disposal by TEAD personnel.

To evaluate whether contaminants are being released to the environment from the remaining propellant at SWMU 40, 10 surface and 5 subsurface (2-foot) soil samples were collected directly beneath selected fragments of propellant. The chemical compositions of each type of propellant were obtained from TEAD prior to the start of sampling activities. From this information, a suite of analytes specific to propellants was identified for laboratory analysis (see Table 2-3 of Section 2.4). Propellant sample locations are shown on Figure 6-12.

Due to the rejection of explosives data for twelve samples obtained from test pits during Phase II activities at SWMU 40 in 1994, three additional test pits (Figure 6-12) were excavated and sampled in November 1995 to confirm the presence or absence of explosives contaminants in the immediate area of the previous locations. Nine samples were collected for explosives analysis.

6.2.3 Contamination Assessment

6.2.3.1 *Data Evaluation*

This section evaluates the analytical data for its usability in the risk assessment. A data evaluation was performed by reviewing the data quality codes assigned by the USAEC Chemistry Branch and EcoChem, an independent third-party validator. In an effort to ascertain the level of certainty/uncertainty, USEPA data qualification codes were then assigned as an aid in interpreting the data for use in the risk assessment. (Table 2-4 defines the relationship between the USAEC Chemistry Branch codes and USEPA data qualifiers.) The following sections summarize the results of this process.

6.2.3.1.1 ***Field Duplicates.*** The "D" flag code represents a field duplicate. All "D" flagged data were compared with the primary investigative result, and the higher of the two values was used in the quantitative risk assessment.

6.2.3.1.2 ***Blank Assessment.*** The USEPA has determined that when blank contamination exists, the investigative results must exceed the blank result by a factor of 5 (all compounds) or 10 (common laboratory contaminatants such as acetone) in order to be considered positive. Several metals were detected in method blanks and or other blanks associated with SWMU 40 soil samples. Based on comparisons to blanks, positive results were changed to nondetects for the following samples. Per USEPA guidance (USEPA 1989), the associated blank concentration was considered the quantitation limit for the affected samples.

- Surface Soil (0 to 0.5 foot)
  –Aluminum—ARP-94-36A
  –Manganese—ARP-94-15A, -36A, and -48A.
  –Vanadium—ARP-94-15A, -34A, -35A -36A, -37A, -38A, -39A, -40A, -41A, -42A, -44A, -50A, -54A, -56A, and -57A.

- Subsurface Soil (0.5 to 10 feet)
  –Aluminum—ARP-94-03C, -04C, -13B, -14B, -14C, -15C, -21C, -22C, -26C, -31C, -34B, -36B, -36C, -37C, -38B, -38C, -39B, -40B, -40C, -41B, -41C, -42B, -42C, -43B, -43C, -45C, -46B, -46C, -47B, -47C, -48C, -49B (and duplicate), -49C (and duplicate), -50B, -50C, -51B, -51C, -53B, -54C, -56B, -56C, -58C, -59C, and -60C.

  –Barium—ARP-94-03C, -04C, -14B, -14C, -31C, -32C, -33C, -34C, -39B, -39C, -41B, -42B, -42B, -42C, -43B, -43C, -45C, -46B, -47B, -47C, -48B, -48C, -49B (and duplicate), -49C (and duplicate), -50B, -50C, -51B, -51C, -53B, -54C, -56B, -56C, -58C, -59C, and -60C.
  –Calcium—ARP-94-14C.
  –Chromium—ARP-94-22C, -29C, -45C, -47B, -48C, -49B, -49C, -50B, -51B, -51C, -53B, -54B, -54C, -56B, and -59C.
  –Iron—ARP-94-03C, -39B, -40C, -40B, -42B, -42C, -46B, -46C, -47B, -47C, -48B, -48C, -49C (and duplicate), -04C, -12B, -14B, -14C, -29C, -39B, -40B, -40C, -41C, -42B, -42C, -43B, -43C, -45C, -46B, -46C, -47B, -47C, -48B, -48C, -49B (and duplicate), -49C (and duplicate), -50B, -50C, -51B, -51C, -53B, -53C, -54C, -56B, -56C, -59B, -59B, and -60C.
  –Manganese—ARP-94-03C, -04C, -12B, -14B, -14C, -29C, -39B, -40B, -40C, -41C, -42B, -42C, -43B, -43C, -45C, -46B, -46C, -47B, -47C, -48B, -48C, -40B (and duplicate), -49C (and duplicate), -50B, -50C, -51B, -51C, -53B, -53C, -54C, -56B, -56C, -59B, -59C, and -60C.
  –Potassium—ARP-94-03C, -04C, -13B, -13C, -14B, -14C, -15C, -22C, -23C, -26B, -26C, -31C, -36C, -37C, -38B, -38C, -39B, -42B, -42C, -43B, -43C, -45C, -46B, -46C, -47B, -48C, -49B (and duplicate), -49C (and duplicate), -50B, -50C, -51B, -51C, -53B, -54C, -56B, -58C, -59C, and -60C.
  –Vanadium—ARP-94-13B, -14B, -32C, -34B, -35B, -35C, -36B, -36C, -37C, -38B, -38C, -39B, -30C, -40B, -40C, -41B, -42B, -42C, -43B, -43C, -45C, -46C, -47B, -48B, -49B (and duplicate), -49C (and duplicate), -50B, -50C, -51B, -51C, -53B, -53C, -54B, -54C, -55B, -55C, -56B, -57B, -58B, -58C -59C, and -60C.

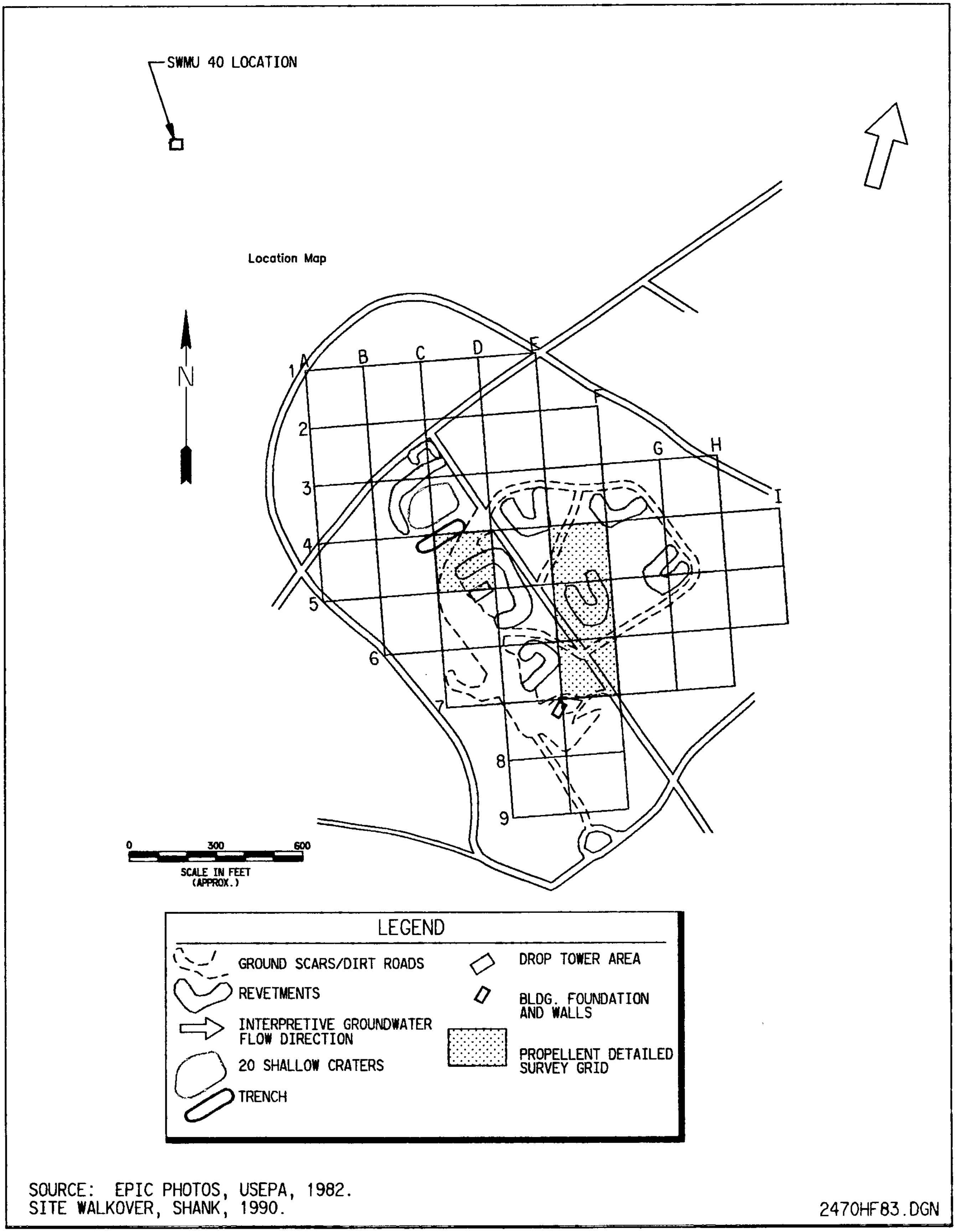

Figure 6-11. SWMU 40 UXO, Debris, and Propellant Grid

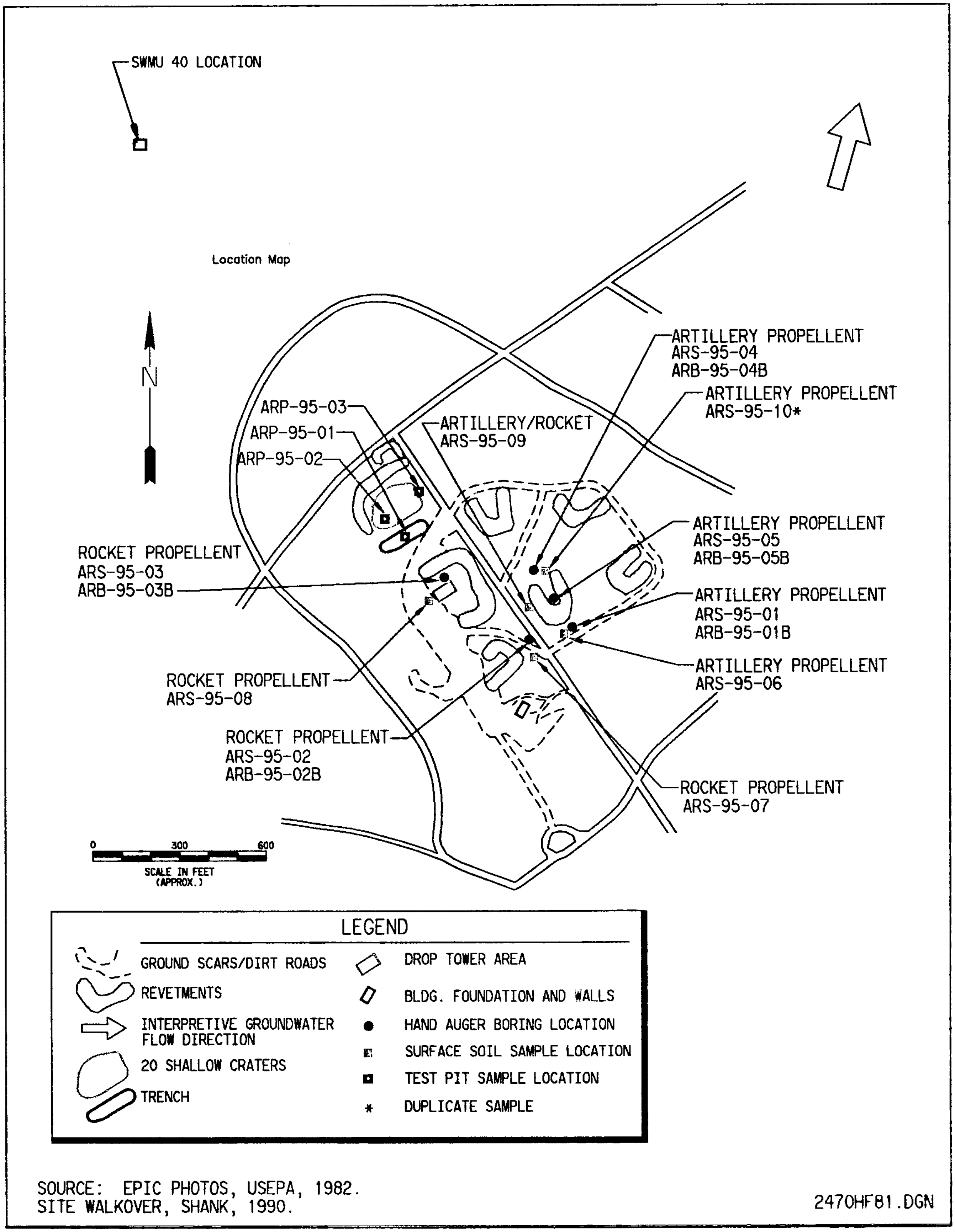

Figure 6-12. SWMU 40 Phase II Propellant Sample Locations

-Zinc—ARP-94-03C, -04C, -14C, -18B, -22C, -29C, -38B, -39B, -39C, -40B, -42B, -42C, -43B, -43C, -46B, -46C, -47B, -47C, -48B, -48C, -49B, -49C, -49C, -50B, -50C, -51B, -51C, -53B, -53C, -54C, -56B, -56C, -59B, -59C, and -60C.

6.2.3.1.3 ***Duplicate Data from Different Methods.*** Both 2,4-dinitrotoluene and 2,6-dinitrotoluene were analyzed as explosives (HPLC) and as SVOCs (GCMS) for 1992 and 1995 samples in the SWMU 40 data set. For a given sample, if there was a detection with one method, the detected value was used in the risk assessment. If both values were detects, the highest detected value was used. If both values were nondetects, 1/2 of the lower nondetect value was used. These chemicals were analyzed only as explosives for 1994 samples. Soil samples collected in 1995 at this SWMU were analyzed for nitrate/nitrite (nonspecific). The analytical results for these samples were treated as nitrate, which would be expected to be the predominant species (Hem 1985).

6.2.3.1.4 ***USAEC Chemistry Branch Validation.*** The USAEC Chemistry Branch reviewed the analytical data for technical deficiencies based on the *USATHAMA (USAEC) Quality Assurance Program (PAM 11-41)*. USAEC data qualifiers assigned by the Chemistry Branch would be an indication of QC recoveries outside of USAEC control limits and other technical deficiencies. Estimating the data for use in the risk assessment based on USAEC data qualifiers is judged to be a conservative approach since USAEC control limits are generally narrower than USEPA Functional Guidelines.

For SWMU 40, the USAEC rejected all explosive results for Lot AMJY (all non-detects) and all antimony results for Lot ANCV (also all non-detects) due to poor spike recoveries. These results were rejected (R) for use in the risk assessment and considered unusable for any purpose. A listing of all rejected sample results for SWMU 40 follows the independent third-party validation.

Several analytes were assigned qualifiers by the USAEC Chemistry Branch due to poor spike recovery values (1,3,5-trinitrobenzene, antimony and vanadium). These were estimated (J/UJ) for use in the risk assessment and considered to be biased low. Analytes flagged by the USAEC Chemistry Branch due to high recoveries are: mercury, selenium, nickel, and arsenic. Positive results within the concentration range of the out-of-control spike were estimated (J) and considered to be biased high. USEPA data qualifiers assigned and incorporated for use in the risk assessment are provided in the analytical summary tables of Appendix J.

Non-Certified Compounds. USAEC flag codes of R or T were assigned by the analytical laboratory to indicate non-detected compounds that had not been performance demonstrated or validated under the USAEC's 1990 QA program. Under this program, a distinction is made between "target" and "non-target" analytes. "Target" compounds are determined during the certification process, and CRLs for these analytes are established. "Non-target" compounds are those that were added to the method to meet project-specific requirements. The lowest calibration standard typically reflects the PQL for that analyte. For the purpose of the risk

assessment, the detection limit was assigned a J-code, due to the uncertainty associated with not having undergone a rigorous certification process.

6.2.3.1.5 ***Independent Third-Party Data Validation.*** For 1994 data, a data quality assessment was completed using a validation effort by EcoChem, an independent third party. EcoChem's review and recommendations were based on USEPA Functional Guidelines as well as the *USATHAMA (USAEC) Quality Assurance Program (PAM 11-41)* and individual methods. All USEPA data qualifiers recommended by EcoChem were incorporated for use in the risk assessment and are provided in the analytical summary tables of Appendix J.

For SWMU 40, 1994 data, EcoChem evaluated three lots of explosive analyses of soil samples by Method LW23 and one lot of ICP metals analyses of soil samples by Method JS12.

For the explosive data, Lot AMGX was acceptable for use without qualification. Lot AMIE had all 1,3,5-trinitrobenzene detection limits qualified (UJ) due to low spike recovery values. (Also qualified by the USAEC Chemistry Branch). Lot AMVC had 1,3,5-trinitrobenzene detection limits rejected (R) due to spike recovery values significantly less than the lower control limit (also rejected by the USAEC Chemistry Branch).
For the ICP metals analyses, Lot ANCV, all antimony detection limits were rejected due to 0 percent MS/MSD recoveries.

For SWMU 40, 1992 data, EcoChem reviewed one lot (MFS) of ICP metals analyses of soil samples by Method JS15. They recommended that all antimony detection limits be rejected (R); beryllium and cadmium results be qualified as estimated (J/UJ); positive copper results be qualified as estimated (J), and non-detects be rejected (R) as a result of poor MS/MSD recoveries.

Listed below are all SWMU 40 sample results rejected for use in the risk assessment:

- Surface Samples
  –1,3,5-Trinitrobenzene—ARP-94-22A, -23A, -24A, -25A, and -57A, -58A, -59A, 60A,
  –1,3,-Dinitrobenzene—ARP-94-22A, -23A, -24A, -25A
  –2,4,6-Trinitrotoluene—ARP-94-22A, -23A, -24A, -25A
  –2,4-Dinitrotoluene—ARP-94-22A, -23A, -24A, -25A
  –2,6-Dinitrotoluene—ARP-94-22A, -23A, -24A, -25A
  –HMX—ARP-94-22A, -23A, -24A, -25A
  –RDX—ARP-94-22A, -23A, -24A, -25A
  –TETRYL—ARP-94-22A, -23A, -24A, -25A
  –Nitrobenzene—ARP-94-22A, -23A, -24A, -25A
  –Antimony—ARS-92-101, -201, -301, -401, -B01, -B02, -B03, -B04, -R21, -R31, -R61 and ARP-94-11A, -12A, -13A, -14A, -15A, -16A, -17A, -18A, -19A, -20A, -21A

- Subsurface Samples
  - –1,3,5-Trinitrobenzene—ARP-94-22B, 22C, -23B, -23C, -24B, -24C, -25B, -25C and -57B, 57C, -58B, -58C, -59B, -59C,- 60B, -60C
  - –1,3,-Dinitrobenzene—ARP-94-22B, 22C, -23B, -23C, -24B, -24C, -25B, -25C
  - –2,4,6-Trinitrotoluene—ARP-94-22B, 22C, -23B, -23C, -24B, -24C, -25B, -25C
  - –2,4-Dinitrotoluene—ARP-94-22B, 22C, -23B, -23C, -24B, -24C, -25B, -25C
  - –2,6-Dinitrotoluene—ARP-94-22B, 22C, -23B, -23C, -24B, -24C, -25B, -25C
  - –HMX—ARP-94-22B, 22C, -23B, -23C, -24B, -24C, -25B, -25C
  - –RDX—ARP-94-22B, 22C, -23B, -23C, -24B, -24C, -25B, -25C
  - –TETRYL—ARP-94-22B, 22C, -23B, -23C, -24B, -24C, -25B, -25C
  - –Nitrobenzene—ARP-94-22B, 22C, -23B, -23C, -24B, -24C, -25B, -25C
  - –Antimony—ARP-92-101, -201, -301, -402, and ARP-94-11B, -11C, -12B, -12C, -13B, -13C, 14B, -14C, -15B, -15C, -16B, -16C, -17B, -17C, -18B, -18C, -19B, -19C, -20B, -20C, -21B, -21C,
  - –Copper—ARP-92-201

For 1995 data, one lot of soil data and one lot of water samples for SVOC analysis were reviewed by EcoChem. Three unknowns (non-target analytes) were detected in the method blank associated with the soil samples. All results for these compounds in the associated samples were rejected. All remaining unknowns were qualified as JN. The CRLs for both lots were estimated (UJ) for pentachlorophenol, 2,4-dinitro-2-methylphenol, and kepone due to poor instrument response. All benzidine values were rejected due to inadequate and erratic instrument response; however, there were no positive detects. All aniline detection limits were rejected. All PCBs and toxaphene values were rejected since they were not included in the calibration standards. There were no detects of any of these compounds in the samples. Two lots of explosives in soil and two lots of explosives in water data were reviewed, and no qualifiers were assigned to any of the data. One lot of soil data for nitrocellulose was reviewed, and all of the data were rejected due to an excessively high blank contamination and very low MS/MSD recoveries. Communications with the analytical laboratory project manager revealed that such results are very typical of this particular analysis and that the method lacks sensitivity and specificity. In addition, the method is very difficult to run and is prone to analytical interferences. The lot was reanalyzed past the holding time under analytical conditions specified by Rust E&I and Ecochem to evaluate the second set of data.

One of the problems associated with this method is the use of Rocky Mountain Arsenal (RMA) soil in the method blank. The samples were rerun using clean sand for the method blank and additional rinses during the sample preparation. The single lot of water data for nitrocellulose analysis was acceptable, and no qualifiers were assigned. One lot of soil data for nitroguanidine analysis was reviewed. All positive results were J-estimated due to high percent recovery in the initial calibration verification. No qualifiers were issued to the single lot of water sample data for nitroguanidine analysis. No qualifiers were assigned to the single soil lot for PETN/nitroglycerine analysis; however, all detection limits for the water data were estimated (UJ) due to low percent recoveries in the continuing calibration verification. One lot each of soil and water data for ethyl centralite analysis were reviewed and no qualifiers were assigned. No perchlorate was detected in the two lots of soil and water data (1 lot each); however, the detection limits were estimated (UJ) in the soil data only due to MS/MSD

percent recovery values, which were slightly less than the recommended limit of 75 percent. One lot each of soil and water data were reviewd for conventional parameter analyses. No qualifiers were assigned to the data reviewed for cyanide, nitrate, or sulfate.

6.2.3.1.6 ***Data Evaluation Summary.*** A total of 84 surface soil samples (and 4 duplicates) and 136 subsurface samples (and 7 duplicates) were collected in 1992, 1994, and 1995 from 3 soil borings, 63 test pits, and 17 surface locations at SWMU 40. Samples from the borings were collected at 1 foot and 2 feet. Test pit samples were typically collected from 0, 3, and 5 feet. Samples were analyzed for one or more of the following groups of chemicals: anions, metals, explosives, and semivolatiles.

Because of blank contamination, positive results for a number of metals were changed to nondetects. However, the detected values in the affected samples were below background screening levels for the metals, indicating that this issue does not significantly impact the risk assessment results.

Antimony and thallium were not detected in any soil samples. The antimony and thallium reporting limits exceed the background screening values (15 μg/g and 11.7 μg/g, respectively) for these metals. Additionally, 49 antimony nondetect results were rejected due to poor matrix spike recoveries. However, the current use PRGs calculated by Dames and Moore (1996) (136 to 467 μg/g for antimony and 98.1 to 1330 μg/g for thallium) are significantly higher than the above-mentioned reporting limits. Therefore, no data gap exists under current use conditions. However, additional sampling may be necessary prior to any future residential land use.

Reporting limits for cadmium (1.2 μg/g) and silver (0.80 μg/g) were above their respective background screening values but less than their respective ingestion and soil-to-air RBCs. Therefore, this issue does not significantly impact the risk assessment results.

Explosives nondetect results were rejected in all 1994 samples from four test pits due to poor recoveries in standard spikes. Three test pits were excavated in these same areas in 1995, and no explosives were detected in samples collected from three depths. An additional 12 nondetect 1,3,5-trinitrobenzene results from 4 other test pits were also rejected due to poor recoveries in standard spikes. However, this compound was detected in only 1 of almost 200 valid sample results. Therefore, the issue of rejected nondetects for explosives in some locations does not significantly impact the risk assessment results.

Approximately 98 percent of sample results were judged to be usable for risk assessment purposes. The number of samples and the analytical parameter list appear to be sufficient to characterize the nature, extent, and potential magnitude of contamination at this SWMU with exceptions noted above. A summary of chemicals detected in at least one surface or subsurface soil sample at SWMU 40 is presented in Appendix J, including corresponding data qualifiers (as appropriate) based on USEPA functional guidelines.

6.2.3.1.7 ***Background Screening.*** The maximum concentrations of inorganic chemicals detected in soil at SWMU 40 were compared to the site-specific background screening values

(see Section 2.6). Any inorganic chemical detected in at least one sample at a concentration higher than the background screening value was retained in the COPC database. Surface soil and subsurface soil were screened separately. The results of the background screening are shown in Table 6-43.

Based on this screening analysis, aluminum, beryllium, and manganese are the only inorganic analytes that are not considered potential contaminants at SWMU 40 in surface soil. In subsurface soil, arsenic, cobalt, copper, lead, magnesium, mercury, potassium, silver, sodium, and vanadium are potential contaminants.

6.2.3.2 *Summary of Analytical Results*

The list of analytes detected in at least one surface or subsurface soil samples is provided in Table 6-44 for Phase I and Table 6-45 for Phase II data.

6.2.3.3 *Nature and Extent of Contamination*

The Phase I RI performed in 1992 at SWMU 40 (see Figure 6-9) included the collection and analysis of 11 surface soil samples and 5 subsurface soil samples. These samples were analyzed for SVOCs, explosives, metals, and anions. The only SVOCs detected, diethyl phthalate and di-N-butyl phthalate, were limited to trace amounts in one soil sample each (0.939 μg/g and 0.167 μg/g, respectively). Explosives were detected in five of the revetments, consisting of HMX, RDX, tetryl, 2,4,-dinitrotoluene, and 2,4,6-trinitrotoluene. The metals that were detected at concentrations exceeding background consisted of cadmium, copper, lead, silver, and zinc. The anions chloride and nitrate were detected above background concentrations.

A Phase II RI was performed by Rust E&I in August 1994 to further define horizontal and vertical extent of contamination. Work consisted of 60 test pits sampled at depths of 0.5, 3, and 5 feet (see Figure 6-10). The 180 test pit soil samples were analyzed for metals and explosives (Table 6-45). Explosives were detected in surface soils adjacent to the bomb crater area and inside or adjacent to the revetments (Figure 6-13). A significant amount of solidified propellent was observed adjacent to the anomalous areas and were suspected to be a possible source of many soil contaminants. The explosives consisted of 2,4,6-trinitrotoluene, HMX, RDX, 2,4-dinitrotoluene, and 1,3,5-trinitrobenzene (Figure 6-13). ARP-94-46 and ARP-94-56 test pit locations both contained RDX at a depth of 5 feet (1.42 μg/g and 2.09 μg/g, respectively), whereas ARP-94-48, -52, and -56 contained the same explosive (RDX) at a depth of 3 feet. Explosives data for test pits ARP-94-22 through ARP-94-25, adjacent to the bomb decommissioning area, were excluded because of analytical problems that caused the data to be rejected. Additionally, explosives analysis for ARP-94-55C (5 feet) could not be performed due to container breakage during shipping. Explosives were not present in the four test pits (ARP-94-13, ARP-94-14, ARP-94-34, and ARP-94-35) adjacent to the bomb decommissioning area (deactivation furnace foundation) north of the observation bunker. Metals detected at SWMU 40 above background concentrations consisted of mercury, copper, vanadium, cobalt, nickel, lead, chromium, cadmium, barium, zinc, and arsenic. Metals were

primarily concentrated in the surface soils (Figure 6-14) with the exception of mercury, vanadium, arsenic, and cobalt (Figure 6-15). Cobalt was detected above background (6.94 $\mu g/g$) in test pit ARP-94-45 at a depth of 5 feet (7.11 $\mu g/g$). Vanadium above background (28.4 $\mu g/g$) was present in samples ARP-94-05B (3 feet) and ARP-94-07B (3 feet), and in duplicate samples ARP-94-09B (3 feet) and ARP-94-09C (5 feet). Concentrations ranged from 28.5 $\mu g/g$ to 29.9 $\mu g/g$. Both cobalt and vanadium just slightly exceed their respective background concentrations and are likely due to natural variations in background. Mercury is the most predominant metal detected in subsurface soils (5 feet) across the site, ranging from 0.058 $\mu g/g$ to 0.395 $\mu g/g$ with the highest concentrations present in samples ARP-94-19 at 0.395 $\mu g/g$ and ARP-94-36 at 0.168 $\mu g/g$ (Figure 6-15). Arsenic was also detected above background in six subsurface soil samples (3 feet to 5 feet), ranging from 12.3 $\mu g/g$ to 29.3 $\mu g/g$. Most of these detections were just slightly above the background value of 11.69 $\mu g/g$.

The results of the walking survey conducted across the entire SWMU 40 area indicate that various types of explosive ordnance debris and propellant still exist in specific areas in spite of previous surface cleanup activities by TEAD AED personnel. Figure 6-16 shows the distribution of the major types of debris identified at SWMU 40. The most frequently encountered debris was related to testing of M43A1 Bomblets and 90mm heat round munitions. Figure 6-17 shows the location of seven UXO devices that were identified during the walking survey and subsequently destroyed in place by TEAD AED personnel on December 14, 1995, under an emergency permit issued by the State of Utah. Five of the items were M43A1 Bomblets; one was a 90mm heat round; and one was a 40mm projectile. All of the UXO items as well as other significant amounts of debris were located in the southern portion of the SWMU outside the revetments. Little debris was found to be present north of the revetments.

In addition, several areas containing abundant rocket and artillery propellant fragments were identified during the walking survey as shown in Figure 6-11. Surface and subsurface soil samples were collected at locations immediately beneath different types of propellant located on the ground surface in order to determine if contaminants are being released from the propellant to the soils at SWMU 40. Chemical compositions of each type of propellant were obtained from AED personnel prior to sampling as shown in Table 6-46. On the basis of these compositions, soil samples, collected at the surface and at a depth of 2 feet, were analyzed for specific contaminants including anions, explosives, nitrocellulose, nitroguanidine, nitroglycerine, and phthalates. Table 6-45 shows the results of these analyses. The explosives RDX (three samples and one duplicate) and HMX (two samples) were detected in surface soils with maximum concentrations of 45.3 $\mu g/g$ and 4.74 $\mu g/g$, respectively (Figure 6-18). These explosive contaminants are not likely, as shown by propellant compositions on Table 6-46, to be related to the propellant fragments and are the result of other testing activities at SWMU 40. Nitrates/nitrites were detected in low concentrations in 7 of 10 surface samples, ranging from 1.09 to 7.45 $\mu g/g$. Sulfate was also present in low concentrations in four samples ranging, from 5.62 to 16.6 $\mu g/g$. Nitroguanidine, a component of at least five types of propellant, was also detected in four samples (and one duplicate) in concentrations ranging from 0.08 to 0.35 $\mu g/g$. Nitroglycerine, a common component of propellant, was detected in only one sample at a concentration of 0.68 $\mu g/g$.

Table 6-43. Background Screening of Inorganic Chemicals Detected in Soil at SWMU 40

Chemical	Frequency of Detection[a]	Maximum Detected Value (μg/g)	Site-specific Background Screening Value[b] (μg/g)	Exceeds Site-specific Background?
Surface Soil				
Aluminum	59/60	18,500	28,083	No
Arsenic	60/71	17.9	11.69	YES
Barium	71/71	2,800	247	YES
Beryllium	19/71	0.848	1.46	No
Cadmium	8/71	6.31	0.847	YES
Calcium	60/60	140,000	114,483	YES
Chromium	71/71	44.3	20.72	YES
Cobalt	55/60	8.78	6.94	YES
Copper	71/71	224	24.72	YES
Iron	71/71	23,200	22,731	YES
Lead	64/71	1,600	18.23	YES
Magnesium	60/60	51,800	7,062	YES
Manganese	57/60	499	698	No
Mercury	6/71	0.096	0.0572	YES
Nickel	60/71	25.0	17.40	YES
Potassium	60/60	6,300	5,450	YES
Silver	11/71	0.930	0.66	YES
Sodium	60/60	9,970	337	YES
Vanadium	45/60	49.6	28.39	YES
Zinc	71/71	665	102.8	YES
Subsurface Soil				
Aluminum	75/120	18,400	28,083	No
Arsenic	118/125	29.3	11.69	YES
Barium	89/125	181	247	No
Beryllium	11/125	0.731	1.46	N
Calcium	119/120	93,000	114,483	No
Chromium	107/125	17.3	20.62	No
Cobalt	94/120	7.11	6.94	YES
Copper	123/125	180	24.72	YES
Iron	105/125	22,700	22,731	No
Lead	44/125	51.0	18.23	YES
Magnesium	120/120	11,000	7,062	YES
Manganese	84/120	408	698	No
Mercury	40/125	0.395	0.0572	YES
Nickel	117/125	14.1	17.40	No
Potassium	78/120	6,100	5,450	YES
Silver	4/125	0.77	0.66	YES
Sodium	120/120	3,150	337	YES
Vanadium	76/120	29.9	28.39	YES
Zinc	91/125	64.3	102.8	No

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]See Section 2.6.1.1 for an explanation of how the site-specific background screening values were calculated.

Table 6-44. Summary of Analytes Detected in Soil for the AED Test Range (SWMU 40) - Phase I

Surface Soil

Group	Analytes	Background Concentrations	ARS-92-101 (0ft)	ARS-92-201 (0ft)	ARS-92-301 (0ft)	ARS-92-401 (0ft)	ARS-92-B01 (0ft)	ARS-92-B02 (0ft)	ARS-92-B03 (0ft)	ARS-92-B04 (0ft)	ARS-92-R21 (0ft)	ARS-92-R31 (0ft)	ARS-92-R61 (0ft)
METALS	BARIUM	247.1	43	110	82	78	85	130	77	84	100	58	91
	CADMIUM	0.847	LT 0.424	LT 0.424	LT 0.424	1.42*	LT 0.424	4.6*	LT 0.424	LT 0.424	LT 0.424	LT 0.424	LT 0.424
	CHROMIUM	20.62	8.16	10.4	9.44	14.4	9.69	12.4	11.8	10.1	12	6.71	10.6
	COPPER	24.72	5.65	24	50*	82*	10	160*	13.3	12.2	13.2	7.11	13.8
	IRON	22731	5500	13000	11000	11000	10000	12000	11000	11000	13000	7200	12000
	LEAD	18.23	17	11	130*	19*	110*	1300*	190*	140*	21*	42*	18
	SILVER	0.66	0.0823	0.0658	0.93*	0.55	0.0736	0.121	0.048	0.108	0.0776	0.52	0.0477
	ZINC	102.8	19.7	150*	150*	170*	30	180*	34	57	43	55	39
SEMIVOLATILES	DI-N-BUTYL PHTHALATE	N/A	ND 0.33	ND 0.33	ND 0.33	0.167*	ND 0.33	ND 0.33	ND 0.33	ND 0.33	ND 0.33	ND 0.33	ND 0.33
	DIETHYL PHTHALATE	N/A	ND 0.33	ND 0.33	0.939*	ND 0.33	ND 0.33	ND 0.33	ND 0.33	ND 0.33	ND 0.33	ND 0.33	ND 0.33
ANIONS	NITRATE	N/A	5.05*	4.3*	11.2*	5.12*	7.04*	LT 3.36	4.34*	5.74*	LT 3.36	LT 3.36	LT 3.36
EXPLOSIVES	2,4-DINITROTOLUENE	N/A	LT 0.744	LT 0.744	LT 0.744	1.41*	LT 0.744	LT 0.744	LT 0.744	LT 0.744	LT 0.744	LT 0.744	LT 0.744
	2,4,6-TRINITROTOLUENE	N/A	LT 0.931	LT 0.931	LT 0.931	LT 0.931	LT 0.931	LT 0.931	LT 0.931	LT 0.931	LT 0.931	LT 0.931	6.84*
	HMX	N/A	LT 0.765	3.82*	LT 0.765	5.92*	LT 0.765	LT 0.765	LT 0.765	LT 0.765	LT 0.765	1.49*	LT 0.765
	RDX	N/A	LT 0.445	1.45*	LT 0.445	44*	LT 0.445	LT 0.445	LT 0.445	LT 0.445	LT 0.445	LT 0.445	LT 0.445

Subsurface Soil

Group	Analytes	Background Concentrations	ARP-92-101 (9ft)	ARP-92-201 (7ft)	ARP-92-301 (10ft)	ARP-92-401 (2.7ft)	ARP-92-402 (8.5ft)
METALS	BARIUM	247.1	46	14	24	110	34
	CHROMIUM	20.62	6.22	LT 7.8	LT 3.9	11	6.32
	COPPER	24.72	3.9	LT 3.9	3.14	180*	5.36
	IRON	22731	8100	10000	4700	15000	8900
	LEAD	18.23	6.2	2.5	5.6	51*	8.1
	MERCURY	0.0572	LT 0.0259	LT 0.0259	0.0309	LT 0.0259	LT 0.0259
	SILVER	0.66	0.0199	LT 0.0146	0.0236	0.77*	0.0246
	ZINC	102.8	16.1	LT 16	11.5	56	16.7
ANIONS	CHLORIDE	N/A	LT 39.6	LT 39.6	LT 39.6	56.4*	LT 39.6
	NITRATE	N/A	LT 3.36	LT 3.36	LT 3.36	115*	LT 3.36
EXPLOSIVES	2,4-DINITROTOLUENE	N/A	LT 0.744	LT 0.744	LT 0.744	2.91*	LT 0.744
	2,4,6-TRINITROTOLUENE	N/A	LT 0.931	LT 0.931	LT 0.931	2.86*	LT 0.931
	HMX	N/A	LT 0.765	LT 0.765	LT 0.765	2.37*	LT 0.765
	RDX	N/A	LT 0.445	LT 0.445	0.806*	34*	LT 0.445
	TETRYL	N/A	LT 1.04	LT 1.04	LT 1.04	18*	LT 1.04

Note.- All values in $\mu g/g$ (equal to ppm).

N/A = Not Applicable.

LT = Analyte concentration is less than CRL , the CRL is posted next to the "LT".

ND = Analyte not detected above the MDL, the MDL is posted next to the "ND".

* = Organic analyte detected above CRL or MDL or detected inorganic analyte exceeding background.

Table 6-45. *Summary of Analytes Detected in Soil for the AED Test Range (SWMU 40) - Phase II*

Surface Soil

Group	Analytes	Background Concentrations	ARP-94-01A (0.5ft)	ARP-94-02A (0.5ft)	ARP-94-03A (0.5ft)	ARP-94-04A (0.5ft)	ARP-94-05A (0.5ft)	ARP-94-06A (0.5ft)	ARP-94-07A (0.5ft)	ARP-94-08A (0.5ft)	ARP-94-09A (0.5ft)	ARP-94-09A(D) (0.5ft)	ARP-94-10A (0.5ft)	ARP-94-11A (0.5ft)
EXPLOSIVES	1,3,5-TRINITROBENZENE	N/A	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922
	2,4,6-TRINITROTOLUENE	N/A	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2
	2,4-DINITROTOLUENE	N/A	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5
	HMX	N/A	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2
	NITROGLYCERINE	N/A	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	NITROGUANIDINE	N/A	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	RDX	N/A	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28
	TETRYL	N/A	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11
METALS	ALUMINUM	28083	10100	15800	18100	12800	17100	13400	17100	18500	12800	13600	8940	11800
	ARSENIC	11.69	9.03	4.71	5.49	4.28	5.43	4.48	4.49	5.03	3.59	4.56	3.38	4.87
	BARIUM	247.1	86.4	133	163	108	138	123	156	171	115	119	72	98.4
	BERYLLIUM	1.455	LT 0.427	0.607	0.73	0.52	0.623	0.542	0.659	0.689	0.507	0.52	LT 0.427	0.477
	CADMIUM	0.847	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2
	CALCIUM	114483	30600	11900	10900	6820	8350	8400	13600	18100	6540	8310	6030	4690
	CHROMIUM	20.62	12.7	17.3	19	13.9	18.1	13.9	16.6	18.4	13.9	14.7	11.3	13.4
	COBALT	6.94	3.16	4.38	6.22	3.73	5.26	3.74	4.95	5.31	3.88	4.07	3.2	3.19
	COPPER	24.72	9.21	13.8	30.1*	14.5	19.8	14.8	13	15.6	23.8	22.4	11.8	10.2
	IRON	22731	10400	15700	18300	13000	16300	13900	16400	16700	13100	14000	12500	13100
	LEAD	18.23	20.6*	9.55	33.6*	12.2	21.3*	13.8	8.31	12.5	23.2*	19.9*	9.42	9.76
	MAGNESIUM	7061	6960	7890*	7420*	5620	6790	7370*	9340*	9760*	5310	5660	3440	5080
	MANGANESE	698.3	229	397	441	310	382	412	484	499	343	347	200	285
	MERCURY	0.0572	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	5.71	8.94	10.5	7.09	8.51	6.82	9.39	9	6.51	7.71	6.25	7.79
	POTASSIUM	5449	2860	5240	5480*	3960	5310	4580	5900*	6300*	4050	4140	2430	3420
	SODIUM	337	206	320	321	280	455*	265	414*	519*	350*	407*	212	211
	VANADIUM	28.39	17.7	25.8	27.4	20.4	29.2*	20.5	26	29.4*	20.4	22.8	17.4	19.8
	ZINC	102.8	44.2	83.5	67.4	45.9	48.6	45.1	50.5	62.2	51.5	48.3	29.4	35.5

Group	Analytes	Background Concentrations	ARP-94-12A (0.5ft)	ARP-94-13A (0.5ft)	ARP-94-14A (0.5ft)	ARP-94-15A (0.5ft)	ARP-94-16A (0.5ft)	ARP-94-17A (0.5ft)	ARP-94-18A (0.5ft)	ARP-94-19A (0.5ft)	ARP-94-20A (0.5ft)	ARP-94-21A (0.5ft)	ARP-94-22A (0.5ft)	ARP-94-23A (0.5ft)
EXPLOSIVES	1,3,5-TRINITROBENZENE	N/A	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922
	2,4,6-TRINITROTOLUENE	N/A	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2
	2,4-DINITROTOLUENE	N/A	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5
	HMX	N/A	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2
	NITROGLYCERINE	N/A	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	NITROGUANIDINE	N/A	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	RDX	N/A	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28
	TETRYL	N/A	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11
METALS	ALUMINUM	28083	13100	17500	8380	5530	10900	18200	17300	6430	9760	15400	12400	9160
	ARSENIC	11.69	6	14.3*	7.22	5.64	5.03	5.08	5.57	5.92	4.05	9.41	5.44	5.1
	BARIUM	247.1	112	176	80.9	63.8	108	150	134	81.9	93	124	119	100
	BERYLLIUM	1.455	0.54	0.848	LT 0.427	LT 0.427	0.485	0.632	0.655	LT 0.427	LT 0.427	0.564	0.608	0.518
	CADMIUM	0.847	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2
	CALCIUM	114483	10600	76000	27400	21100	16000	16500	12600	33100	18400	16600	25300	11600
	CHROMIUM	20.62	14.2	18.2	15.5	7.72	12	18.8	17.9	9.47	11.7	17	13.7	11.9
	COBALT	6.94	3.32	8.78*	3	LT 2.5	3.4	4.55	5.44	2.98	3.3	4.48	5.15	3.15
	COPPER	24.72	17.8	40.8*	7.54	6.47	10	11.9	12.6	9.26	9.17	16.1	14.4	25.9*
	IRON	22731	14900	23200*	11200	7980	13400	16000	17100	10200	12000	16600	15700	14900
	LEAD	18.23	16.2	48.4*	18	9.19	12.7	11.5	10.9	LT 7.44	9.25	17.2	11.4	34.4*
	MAGNESIUM	7061	6040	10200*	4580	2870	6990	8790*	8460*	2760	5070	6640	6950	5620
	MANGANESE	698.3	317	344	149	99.3#	310	397	392	130	223	326	291	320
	MERCURY	0.0572	LT 0.05	0.0959*	LT 0.05	0.058*	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	9.51	17.7*	7.78	5.01	7.84	9.14	11	6.27	6.68	9.08	9.63	9.46
	POTASSIUM	5449	4270	4130	2140	1430	3560	5970*	5690*	1760	3410	4990	4370	3070
	SODIUM	337	233	502*	229	192	204	513*	359*	103	582*	310	201	119
	VANADIUM	28.39	22.1	29*	18.7	12.5#	18.7	27.3	25.5	15.8	18.5	25	20	16.9
	ZINC	102.8	42.5	63.7	29.4	17.5	38.3	45.3	50.1	25.4	31.2	51	47.5	60.4

Table 6-45. Summary of Analytes Detected in Soil for the AED Test Range (SWMU 40) - Phase II (continued)

Surface Soil

Group	Analytes	Background Concentrations	ARP-94-24A (0.5ft)	ARP-94-25A (0.5ft)	ARP-94-26A (0.5ft)	ARP-94-27A (0.5ft)	ARP-94-28A (0.5ft)	ARP-94-29A (0.5ft)	ARP-94-29A(D) (0.5ft)	ARP-94-30A (0.5ft)	ARP-94-31A (0.5ft)	ARP-94-32A (0.5ft)	ARP-94-33A (0.5ft)	ARP-94-34A (0.5ft)
EXPLOSIVES	1,3,5-TRINITROBENZENE	N/A	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922
	2,4,6-TRINITROTOLUENE	N/A	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2
	2,4-DINITROTOLUENE	N/A	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5
	HMX	N/A	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2
	NITROGLYCERINE	N/A	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	NITROGUANIDINE	N/A	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	RDX	N/A	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28
	TETRYL	N/A	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11
METALS	ALUMINUM	28083	7190	8400	13200	8270	11300	12400	12400	8810	13000	9300	11500	5620
	ARSENIC	11.69	5.31	6.65	6.18	4.82	5.65	5.26	4.99	5.5	11.7*	4.77	4.15	6.89
	BARIUM	247.1	75.2	97.7	123	75.8	101	104	101	97.5	91.1	89.5	95.9	248*
	BERYLLIUM	1.455	LT 0.427	LT 0.427	0.668	LT 0.427	0.561	0.552	LT 0.427	LT 0.427	LT 0.427	LT 0.427	0.487	LT 0.427
	CADMIUM	0.847	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2
	CALCIUM	114483	16600	28000	16500	6140	19900	14600	14100	16400	85000	20000	14700	26300
	CHROMIUM	20.62	9.68	10.4	14.4	9.99	14.1	14.6	15.1	10.9	15.4	12.1	14.5	10.7
	COBALT	6.94	3.53	3.58	3.28	2.84	3.62	3.6	3.68	3.61	3.72	3.91	3.41	3.47
	COPPER	24.72	9.3	12.5	12.7	10.2	11.3	10.5	9.99	11.5	9.74	8.48	8.61	182*
	IRON	22731	10500	12700	15400	10700	12700	13400	13200	13000	13900	12100	12500	9940
	LEAD	18.23	LT 7.44	10.2	8.88	9.08	14.1	8.52	LT 7.44	12.7	10.4	LT 7.44	9.24	1600*
	MAGNESIUM	7061	3620	5330	7330*	4070	4770	5560	5390	5210	10300*	4930	4690	4660
	MANGANESE	698.3	197	226	351	233	207	265	255	243	212	212	226	176
	MERCURY	0.0572	LT 0.05	0.0577*	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	6.69	7.49	8.74	7.11	8.48	7.52	7.04	8.06	11.5	6.88	6.67	5.23
	POTASSIUM	5449	2120	2500	4700	2840	3460	3960	4000	2690	3270	2900	3550	1890
	SODIUM	337	108	124	172	117	199	198	203	132	2830*	155	192	88.1
	VANADIUM	28.39	14.6	16.7	20.6	14.4	20.3	20.9	21.2	16.8	25.3	18.8	20.9	12.3#
	ZINC	102.8	28.3	36.7	45	31.5	37.5	37	35	36.7	33.3	30.9	33.3	162*

Group	Analytes	Background Concentrations	ARP-94-35A (0.5ft)	ARP-94-36A (0.5ft)	ARP-94-37A (0.5ft)	ARP-94-38A (0.5ft)	ARP-94-39A (0.5ft)	ARP-94-40A (0.5ft)	ARP-94-41A (0.5ft)	ARP-94-42A (0.5ft)	ARP-94-43A (0.5ft)	ARP-94-44A (0.5ft)	ARP-94-45A (0.5ft)	ARP-94-46A (0.5ft)
EXPLOSIVES	1,3,5-TRINITROBENZENE	N/A	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922
	2,4,6-TRINITROTOLUENE	N/A	LT 2	LT 2	LT 2	4.62*	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2
	2,4-DINITROTOLUENE	N/A	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5
	HMX	N/A	LT 2	LT 2	LT 2	3*	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2
	NITROGLYCERINE	N/A	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	NITROGUANIDINE	N/A	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	RDX	N/A	LT 1.28	LT 1.28	LT 1.28	2.31*	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28
	TETRYL	N/A	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11
METALS	ALUMINUM	28083	5020	3300#	5300	7880	7560	6540	6530	7770	12100	6830	15900	13200
	ARSENIC	11.69	11.1	3.86	4.17	4.47	4.52	12.6*	4.23	4.36	4.09	4.79	8.89	7.28
	BARIUM	247.1	73.4	55.1	69.2	87.8	86.6	88.5	95.1	93.7	114	101	300*	112
	BERYLLIUM	1.455	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	0.478	0.536	LT 0.427	0.606	0.522
	CADMIUM	0.847	LT 1.2	LT 1.2	LT 1.2	2.77*	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2	LT 1.2
	CALCIUM	114483	38800	15800	16600	13300	21600	39200	24100	18200	31200	27600	140000*	23400
	CHROMIUM	20.62	8.83	5.39	7.81	9.72	8.47	8.24	7.67	8.63	13.1	8.02	13.4	14.6
	COBALT	6.94	LT 2.5	LT 2.5	3.55	3.71	3.53	3.35	3.58	3.59	3.85	3.73	3.57	4.77
	COPPER	24.72	9.46	143*	26.3*	30.5*	7.95	12.1	7.37	9.2	9.26	8.99	11.1	13.2
	IRON	22731	8300	7360	8900	11100	10700	9830	9760	11700	13300	11500	10900	12600
	LEAD	18.23	36.6*	20.4*	10.1	19.8*	8.11	36.9*	LT 7.44	8.15	LT 7.44	LT 7.44	LT 7.44	16.5
	MAGNESIUM	7061	5450	2520	3430	5020	5110	5790	4460	5660	6500	4680	51800*	5940
	MANGANESE	698.3	158	98.3#	143	255	213	246	184	266	227	215	269	252
	MERCURY	0.0572	LT 0.05	0.0583*	LT 0.05	LT 0.05	LT 0.05	LT 0.05	0.0591*	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	6.08	5.35	4.57	5.73	5.74	6.52	5.34	6.39	7.4	6.69	9.5	8.17
	POTASSIUM	5449	1420	818	1600	2490	2660	2100	2530	2870	3770	2590	4630	4390
	SODIUM	337	90.3	77.4	84.1	107	120	96.6	128	102	270	350*	9970*	362*
	VANADIUM	28.39	11#	10.5#	12.4#	12.8#	13#	12.1#	10.9#	13.4#	19.6	13.5#	26	21.6
	ZINC	102.8	41.7	95.8	33.3	61.1	29.2	59.9	28.1	33.4	35.9	30.3	37.8	48.3

Table 6-45. *Summary of Analytes Detected in Soil for the AED Test Range (SWMU 40) - Phase II (continued)*

Surface Soil

Group	Analytes	Background Concentrations	ARP-94-47A (0.5ft)	ARP-94-48A (0.5ft)	ARP-94-49A (0.5ft)	ARP-94-49A(D) (0.5ft)	ARP-94-50A (0.5ft)	ARP-94-51A (0.5ft)	ARP-94-52A (0.5ft)	ARP-94-53A (0.5ft)	ARP-94-54A (0.5ft)	ARP-94-55A (0.5ft)	ARP-94-56A (0.5ft)	ARP-94-57A (0.5ft)
EXPLOSIVES	1,3,5-TRINITROBENZENE	N/A	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	3.27*	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922
	2,4,6-TRINITROTOLUENE	N/A	LT 2	14.4*	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2
	2,4-DINITROTOLUENE	N/A	LT 2.5	8.15*	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	3.63*	LT 2.5	LT 2.5	LT 2.5
	HMX	N/A	LT 2	485*	LT 2	LT 2	LT 2	LT 20	7.05*	LT 2	3.76*	LT 2	LT 2	LT 2
	NITROGLYCERINE	N/A	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	NITROGUANIDINE	N/A	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	RDX	N/A	LT 1.28	3200*	LT 1.28	LT 1.28	LT 1.28	LT 1.28	9.29*	LT 1.28	10.2*	2.48*	LT 1.28	LT 1.28
	TETRYL	N/A	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11
METALS	ALUMINUM	28083	16000	17200	11400	11700	7320	9180	9230	9450	8480	9450	8430	7820
	ARSENIC	11.69	4.73	4.29	7.36	10.1	5.75	10.5	4.44	4.91	5.21	4.59	17.9*	4.47
	BARIUM	247.1	123	2800*	96.3	112	67.6	87.6	88	80.2	74.9	86.2	96.8	68.5
	BERYLLIUM	1.455	0.594	LT 0.427	0.481	0.536	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427
	CADMIUM	0.847	LT 1.2	3.6*	LT 1.2	LT 1.2	LT 1.2	3.13*	2.37*	LT 1.2	6.31*	LT 1.2	2.11*	LT 1.2
	CALCIUM	114483	14800	9890	21700	26200	34200	22200	20200	31200	12100	15600	33700	6950
	CHROMIUM	20.62	18.3	44.3*	13.3	12.4	10.1	10.9	16.7	13	12.8	10.9	11.4	11.1
	COBALT	6.94	4.33	3.89	5.02	6.19	2.63	2.97	3.92	2.73	2.6	3.66	LT 2.5	3.33
	COPPER	24.72	13.8	43.6*	11.5	14.3	12.4	14.9	224*	22.3	53.2*	17.1	65.3*	10.4
	IRON	22731	14600	13200	13200	14200	8720	11100	12300	11300	11200	11800	9550	10900
	LEAD	18.23	16.3	18.6*	15.3	21.3*	15.6	16.4	25.8*	14.4	18.5*	11.8	66.5*	11
	MAGNESIUM	7061	6230	4640	4970	6010	4420	4300	4820	4890	4400	5090	6490	4130
	MANGANESE	698.3	303	81.6#	229	286	163	197	208	205	220	248	223	206
	MERCURY	0.0572	0.0652*	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	8.4	25*	9.03	9.32	4.84	7.82	9.34	6.5	8.23	7.93	5.89	4.8
	POTASSIUM	5449	5220	3830	3340	3550	1910	2580	3400	2650	2450	3170	2390	2340
	SODIUM	337	420*	761*	240	191	206	230	671*	254	137	154	169	131
	VANADIUM	28.39	26.3	49.6*	19.5	18.6	13.8#	16.7	16.5	17.2	14.2#	16.8	14#	16.9#
	ZINC	102.8	44.5	665*	40.4	50.6	40.8	31	157*	49.5	237*	34.5	86.1	28.4

Group	Analytes	Background Concentrations	ARP-94-58A (0.5ft)	ARP-94-59A (0.5ft)	ARP-94-60A (0.5ft)	ARP-95-01A (0.5ft)	ARP-95-02A (0.5ft)	ARP-95-03A (0.5ft)
EXPLOSIVES	1,3,5-TRINITROBENZENE	N/A	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922
	2,4,6-TRINITROTOLUENE	N/A	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2
	2,4-DINITROTOLUENE	N/A	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5
	HMX	N/A	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2
	NITROGLYCERINE	N/A	NT	NT	NT	NT	NT	NT
	NITROGUANIDINE	N/A	NT	NT	NT	NT	NT	NT
	RDX	N/A	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28
	TETRYL	N/A	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11
METALS	ALUMINUM	28083	15700	14800	10200	NT	NT	NT
	ARSENIC	11.69	4.8	2.54	4.38	NT	NT	NT
	BARIUM	247.1	140	132	77.8	NT	NT	NT
	BERYLLIUM	1.455	0.691	0.624	LT 0.427	NT	NT	NT
	CADMIUM	0.847	LT 1.2	LT 1.2	LT 1.2	NT	NT	NT
	CALCIUM	114483	6020	6280	5840	NT	NT	NT
	CHROMIUM	20.62	17.1	17.4	13.9	NT	NT	NT
	COBALT	6.94	5.26	6.75	LT 2.5	NT	NT	NT
	COPPER	24.72	16.1	16.7	13.2	NT	NT	NT
	IRON	22731	17000	15800	12100	NT	NT	NT
	LEAD	18.23	10.6	18.1	14.4	NT	NT	NT
	MAGNESIUM	7061	7930*	6670	4510	NT	NT	NT
	MANGANESE	698.3	462	395	227	NT	NT	NT
	MERCURY	0.0572	LT 0.05	LT 0.05	LT 0.05	NT	NT	NT
	NICKEL	17.4	9.37	9.14	6.12	NT	NT	NT
	POTASSIUM	5449	5280	4620	3200	NT	NT	NT
	SODIUM	337	262	269	183	NT	NT	NT
	VANADIUM	28.39	24.6	25.6	19.8	NT	NT	NT
	ZINC	102.8	50.7	47.2	34.2	NT	NT	NT

Table 6-45. Summary of Analytes Detected in Soil for the AED Test Range (SWMU 40) - Phase II (continued)

Surface Soil

Group	Analytes	Background Concentrations	ARS-95-01 (0.5ft)	ARS-95-02 (0.5ft)	ARS-95-03 (0.5ft)	ARS-95-04 (0.5ft)	ARS-95-05 (0.5ft)	ARS-95-06 (0.5ft)	ARS-95-07 (0.5ft)	ARS-95-08 (0.5ft)	ARS-95-09 (0.5ft)	ARS-95-10 (0.5ft)	ARS-95-10(D) (0.5ft)
EXPLOSIVES	1,3,5-TRINITROBENZENE	N/A	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922	LT 0.922
	2,4,6-TRINITROTOLUENE	N/A	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2	LT 2
	2,4-DINITROTOLUENE	N/A	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5
	HMX	N/A	LT 2	LT 2	LT 2	LT 2	LT 2	**4.74***	LT 2	LT 2	LT 2	LT 2	**3.15***
	NITROGLYCERINE	N/A	LT 0.51	LT 0.51	LT 0.51	LT 0.51	LT 0.51	**0.681***	LT 0.51	LT 0.51	LT 0.51	LT 0.51	LT 0.51
	NITROGUANIDINE	N/A	**0.0607***	LT 0.0447	LT 0.0447	LT 0.0447	**0.209***	LT 0.0447	LT 0.0447	LT 0.0447	**0.35***	**0.146***	**0.235***
	RDX	N/A	LT 1.28	LT 1.28	LT 1.28	LT 1.28	**2.78***	**45.3***	LT 1.28	LT 1.28	LT 1.28	**5.63***	**43.2***
	TETRYL	N/A	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	LT 2.11	**8.03***
METALS	ALUMINUM	28083	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	ARSENIC	11.69	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	BARIUM	247.1	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	BERYLLIUM	1.455	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	CADMIUM	0.847	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	CALCIUM	114483	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	CHROMIUM	20.62	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	COBALT	6.94	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	COPPER	24.72	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	IRON	22731	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	LEAD	18.23	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	MAGNESIUM	7061	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	MANGANESE	698.3	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	MERCURY	0.0572	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	NICKEL	17.4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	POTASSIUM	5449	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	SODIUM	337	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	VANADIUM	28.39	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	ZINC	102.8	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
ANIONS †	NITRITE, NITRATE - NONSPECIFIC	N/A	LT 1	**3.88***	**1.09***	LT 1	**5.55***	**7.45***	**1.91***	LT 1	**2.89***	**1.63***	LT 1
	SULFATE	N/A	LT 5	**9.11***	LT 5	LT 5	**6.28***	LT 5	LT 5	**16.6***	LT 5	LT 5	LT 5
SEMIVOLATILES †	DIETHYL PHTHALATE	N/A	LT 0.24	LT 0.24	LT 0.24	LT 0.24	**6.8***	LT 0.24	**5.8***	LT 0.24	LT 0.24	**3.1***	LT 0.24
	DIMETHYL PHTHALATE	N/A	LT 0.063	LT 0.063	LT 0.063	LT 0.063	**8.5***	**0.16***	LT 0.063	LT 0.063	LT 0.063	LT 0.063	LT 0.063

Table 6-45. Summary of Analytes Detected in Soil for the AED Test Range (SWMU 40) - Phase II (continued)

Subsurface Soil

Group	Analytes	Background Concentrations	ARP-94-01B (3ft)	ARP-94-01C (5ft)	ARP-94-02B (3ft)	ARP-94-02C (5ft)	ARP-94-03B (3ft)	ARP-94-03C (5ft)	ARP-94-04B (3ft)	ARP-94-04C (5ft)	ARP-94-05B (3ft)	ARP-94-05C (5ft)	ARP-94-06B (3ft)	ARP-94-06C (5ft)	ARP-94-07B (3ft)
EXPLOSIVES	RDX	N/A	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28
METALS	ALUMINUM	28083	6430	6640	8300	6930	9000	3590#	11300	3980#	13100	12500	15900	12100	18400
	ARSENIC	11.69	2.82	3.83	2.94	3.23	3.79	3.18	4.08	9.14	5.26	5.39	3.48	5.5	4.71
	BARIUM	247.1	69.9	57.7	76.2	67.8	94.3	38.8#	103	31.9#	134	103	147	110	171
	BERYLLIUM	1.455	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	0.533	LT 0.427	0.588	0.526	0.722
	CALCIUM	114483	11800	19100	16900	12700	15700	5320	22400	30300	27200	15100	40900	20400	38400
	CHROMIUM	20.82	8.37	12.5	11.1	9.1	10.9	6.21	13.1	7.79	14.2	13.2	15.2	13.2	16.6
	COBALT	6.94	LT 2.5	2.92	3.07	LT 2.5	3.22	LT 2.5	3.17	4.42	5.26	4.41	3.26	3.18	5.78
	COPPER	24.72	5.36	5.7	6.77	6.87	10.6	5	8.62	6.32	11.1	12.6	11.5	9.74	14.4
	IRON	22731	7310	10100	9760	8420	11300	6460#	12200	13300	16600	21000	14400	14200	17600
	LEAD	18.23	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	10.9	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44
	MAGNESIUM	7061	2740	3560	3450	3230	4750	1780	5050	3950	7310*	6230	9750*	5600	11000*
	MANGANESE	698.3	96.7#	125	119	116	205	83.1#	208	88.7#	276	198	331	250	408
	MERCURY	0.0572	LT 0.05	0.0652*	0.125*	0.056	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	3.69	5.99	5.03	4.14	6.97	3.45	6.5	6.05	8.32	10.4	7.99	7.75	9.31
	POTASSIUM	5449	1780	1840	2160	1920	2720	902#	3360	831#	3880	2440	5470*	3500	6020*
	SODIUM	337	332	285	313	343*	180	352*	307	326	938*	441*	1430*	1140*	2060*
	VANADIUM	28.39	13.7	21.7	19.1	15.4	18.2	10.9	20.6	12.3	28.5*	20.8	24.1	23.3	29*
	ZINC	102.8	20.8	23.8	26.5	21.1	34.8	13.8#	32.1	17#	45.7	43	41.9	38.5	52.6

Group	Analytes	Background Concentrations	ARP-94-07C (5ft)	ARP-94-08B (3ft)	ARP-94-08C (5ft)	ARP-94-09B (3ft)	ARP-94-09B(D) (3ft)	ARP-94-09C (5ft)	ARP-94-09C(D) (5ft)	ARP-94-10B (3ft)	ARP-94-10C (5ft)	ARP-94-11B (3ft)	ARP-94-11C (5ft)	ARP-94-12B (3ft)	ARP-94-12C (5ft)
EXPLOSIVES	RDX	N/A	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28
METALS	ALUMINUM	28083	10100	16900	11000	13500	17300	10300	16000	6730	6680	7880	5720	6860	6340
	ARSENIC	11.69	7.65	3.87	4.86	5.11	5.03	4.39	4.7	4.72	4.09	4.41	5.42	4.97	7
	BARIUM	247.1	122	173	102	145	168	119	142	72.8	59.6	76.6	60.2	79.8	55.8
	BERYLLIUM	1.455	LT 0.427	0.731	0.481	0.534	0.665	LT 0.427	0.615	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427
	CALCIUM	114483	21500	31000	19400	31800	35600	49900	29700	20200	31800	17100	14200	19600	18400
	CHROMIUM	20.82	9.73	15.8	12.4	13	16.9	10	16	7.9	9.29	10.7	8.26	9.58	8.12
	COBALT	6.94	3.4	5.73	3.89	5.06	5.32	3.6	4.92	3.69	5.34	3.42	2.75	2.94	3.26
	COPPER	24.72	12	16.4	9.58	9.43	11.1	11.3	11.3	7.16	7.86	5.27	5.67	5.96	7.25
	IRON	22731	12800	18100	13900	15400	15800	14100	15800	10700	13000	10200	9360	9590	11000
	LEAD	18.23	LT 7.44	LT 7.44	8.16	LT 7.44	8.17	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	8.81	LT 7.44	10.6
	MAGNESIUM	7061	6960	9510*	5300	7050	8180*	6450	7340*	3330	3520	2710	2800	3390	4670
	MANGANESE	698.3	303	382	235	262	283	245	301	187	146	150	142	108#	141
	MERCURY	0.0572	LT 0.05	0.0714*	LT 0.05	0.0534	0.0621*	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	0.126*	LT 0.05
	NICKEL	17.4	7.21	11.3	9.81	8.44	9.3	6.71	8.54	5.98	6.68	5.68	5.64	5.44	8.04
	POTASSIUM	5449	3510	6100*	3140	3310	4420	2690	4270	1520	1310	1950	1460	1710	1400
	SODIUM	337	1300*	1220*	961*	339*	496*	283	560*	96.6	205	215	145	280	569*
	VANADIUM	28.39	16.6	24.3	22.4	23.6	29.4*	17.6	29.9*	14.3	15.3	18.6	13.6	15.4	14
	ZINC	102.8	42.1	64.3	37.7	39.2	46.6	37.4	42.9	27	31.2	23.8	22.6	20.9	27.2

Table 6-45. *Summary of Analytes Detected in Soil for the AED Test Range (SWMU 40) - Phase II (continued)*

Subsurface Soil

Group	Analytes	Background Concentrations	ARP-94-13B (3ft)	ARP-94-13C (5ft)	ARP-94-14B (3ft)	ARP-94-14C (5ft)	ARP-94-15B (3ft)	ARP-94-15C (5ft)	ARP-94-16B (3ft)	ARP-94-16C (5ft)	ARP-94-17B (3ft)	ARP-94-17C (5ft)	ARP-94-18B (3ft)	ARP-94-18C (5ft)	ARP-94-19B (3ft)
EXPLOSIVES	RDX	N/A	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28
METALS	ALUMINUM	28083	4410#	5640	3950#	1930#	6760	4160#	10000	7090	9920	7840	6970	10300	13000
	ARSENIC	11.69	5.24	6.14	4.08	5.39	6.44	5.31	6.77	7.73	8.46	6	4.64	11.1	9.45
	BARIUM	247.1	49.7	53.1	26.3#	21.1#	68.4	67.8	91	116	115	108	66.2	105	116
	BERYLLIUM	1.455	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427
	CALCIUM	114483	30900	18200	6420	1190#	42000	19200	46900	40500	64000	34200	14200	20800	81000
	CHROMIUM	20.62	6.7	14.3	7.11	6.68	8.78	10.1	12.6	9.12	12.7	9.76	9.84	12.6	17.3
	COBALT	6.94	2.67	3.97	2.92	LT 2.5	3.51	3.05	3.41	3.44	3.37	2.79	2.9	3.71	3.71
	COPPER	24.72	6.23	5.72	4.23	3.8	6.57	4.98	6.79	8.26	7.06	6.41	5.6	7.86	10.4
	IRON	22731	8940	12200	8780	8000	10800	9990	12400	11700	12700	10100	8540	14800	14600
	LEAD	18.23	15.3	LT 7.44	9.68	7.96	12.6	LT 7.44	9.29	12.8	12	LT 7.44	LT 7.44	12.4	14.7
	MAGNESIUM	7061	6690	4310	1820	922	8880*	3580	8500*	7350*	10500*	6730	2380	4550	10100*
	MANGANESE	698.3	143	135	98.2#	98.7#	163	135	193	179	198	140	121	220	254
	MERCURY	0.0572	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	0.0745*	0.0939*	LT 0.05	0.069*	0.0653*
	NICKEL	17.4	4.7	5.88	6.04	3.96	7.22	5.44	9.8	7.91	10.2	8.39	5.06	12.4	13.7
	POTASSIUM	5449	983#	970#	686#	443#	1370	789#	2140	1530	2270	1820	1700	2080	2940
	SODIUM	337	208	860*	165	94.7	879*	1080*	2080*	2080*	2190*	2310*	364*	1490*	1410*
	VANADIUM	28.39	12.4#	26.9	10.7#	13.9	14.1	18.8	21.2	14.5	19.4	13.1	16.5	23.1	23.5
	ZINC	102.8	20.6	28	17.4	13.5#	25.7	19.5	29	27.6	32.3	21.3	16.2#	33.3	48.3

Group	Analytes	Background Concentrations	ARP-94-19C (5ft)	ARP-94-20B (3ft)	ARP-94-20C (5ft)	ARP-94-21B (3ft)	ARP-94-21C (5ft)	ARP-94-22B (3ft)	ARP-94-22C (5ft)	ARP-94-23B (3ft)	ARP-94-23C (5ft)	ARP-94-24B (3ft)	ARP-94-24C (5ft)	ARP-94-25B (4ft)	ARP-94-25C (7ft)
EXPLOSIVES	RDX	N/A	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28
METALS	ALUMINUM	28083	10500	7660	9110	8690	4530#	6210	1780#	5660	5250	9630	6330	7000	8850
	ARSENIC	11.69	9.21	10.1	8.06	3.93	4.86	10.6	6.06	4.46	19.2*	5.41	9.97	4.66	4.68
	BARIUM	247.1	96	84.9	181	81.4	45.8	86.4	32.4	49.9	148	73.8	83.9	78.1	95.5
	BERYLLIUM	1.455	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	0.61	LT 0.427	LT 0.427	0.503
	CALCIUM	114483	34300	50800	67000	13800	6620	15200	17800	11700	45900	28400	43400	11400	27400
	CHROMIUM	20.62	13	10.3	11.2	11.2	7.75	9.57	5.06#	8.69	8.57	12.8	9.81	8.89	10.7
	COBALT	6.94	4.09	3.46	3.5	3.49	2.76	3.84	LT 2.5	2.78	3.85	4.35	4.09	2.88	4.1
	COPPER	24.72	7.59	6.39	8.41	7.89	5.77	9.8	3.58	6.25	6.72	12.2	10.1	13	12
	IRON	22731	12100	11000	12300	10700	9080	11800	5820	8760	12800	16900	14800	11000	12900
	LEAD	18.23	10.9	9.89	11.7	8.62	LT 7.44	8.61	LT 7.44	LT 7.44	8.95	13.6	13	10.5	11.7
	MAGNESIUM	7061	6450	5980	10700*	4100	2390	3560	1700	3010	6340	7680*	7770*	4510	5250
	MANGANESE	698.3	173	121	178	172	119	132	99.9	108	262	163	135	245	223
	MERCURY	0.0572	0.395*	LT 0.05	LT 0.05	0.0765*	LT 0.05	LT 0.05	0.0765*	LT 0.05	0.085*	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	10.7	9.69	9.34	6.29	5.23	10.2	3.12	4.53	10.9	14.1	8.78	6.6	8.55
	POTASSIUM	5449	2240	1510	1800	2640	1120	1280	343#	1410	895#	1690	1150	2640	2720
	SODIUM	337	1280*	3150*	2440*	1020*	697*	1580*	432*	731*	1280*	2500*	1990*	138	129
	VANADIUM	28.39	24.3	18.4	17.4	18	14.8	18.8	8.89	15	17.7	23.6	19.6	13.6	17.1
	ZINC	102.8	27.9	27.5	28.3	30.2	20.7	25.5	9.85#	19	28.6	36.2	34	36.8	36.8

Table 6-45. Summary of Analytes Detected in Soil for the AED Test Range (SWMU 40) - Phase II (continued)

Subsurface Soil

Group	Analytes	Background Concentrations	ARP-94-26B (3ft)	ARP-94-26C (5ft)	ARP-94-27B (3ft)	ARP-94-27C (5ft)	ARP-94-28B (3ft)	ARP-94-28C (5ft)	ARP-94-29B (3ft)	ARP-94-29B(D) (3ft)	ARP-94-29C (5ft)	ARP-94-29C(D) (5ft)	ARP-94-30B (3ft)	ARP-94-30C (5ft)	ARP-94-31B (3ft)
EXPLOSIVES	RDX	N/A	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28
METALS	ALUMINUM	28083	4360	2980#	4400	5160	9610	10800	8980	9610	3770	5730	10500	9820	4890
	ARSENIC	11.69	9.64	6.59	3.98	3.87	5.07	4.27	4.28	4.08	5.06	4.79	4.52	10.5	8.11
	BARIUM	247.1	81.7	63.3	64.1	51.9	89.1	98.6	90.9	87.4	36.4	45.5	84.3	113	128
	BERYLLIUM	1.465	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427
	CALCIUM	114483	57000	27900	18100	11000	7860	17400	25900	24500	11200	10700	8660	60000	34600
	CHROMIUM	20.62	6.66	7.89	5.99	8.77	12.7	13.4	10.9	11.6	5.54#	8.19	14.7	12.6	7.59
	COBALT	6.94	3.16	2.95	LT 2.5	3.11	3.7	3.6	3.84	3.45	LT 2.5	LT 2.5	3.94	3.72	4.23
	COPPER	24.72	6.29	4.59	5.12	6.59	14.8	8.43	8.01	7.45	4.6	7.36	8.3	6.33	7.73
	IRON	22731	10700	8110	7950	8850	12600	12300	11800	11300	6150	9060	13300	12000	11800
	LEAD	18.23	11.1	LT 7.44	LT 7.44	LT 7.44	14.1	8.02	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	11	10.7
	MAGNESIUM	7061	10600*	3120	2660	2210	4470	4750	5050	4630	2410	2970	4170	6780	6790
	MANGANESE	698.3	183	89	146	124	260	208	207	179	71.6#	88.3	182	112	181
	MERCURY	0.0572	0.0639*	LT 0.05	LT 0.05	0.0904*	LT 0.05	0.0723*	LT 0.05	LT 0.05	LT 0.05	LT 0.05	0.0633*	0.0584*	LT 0.05
	NICKEL	17.4	8.33	4.31	4.41	4.53	8.02	7.2	8.7	8.04	3.76	3.87	8.97	8.04	8.8
	POTASSIUM	5449	959#	722#	1440	1250	2920	3300	2810	2890	1030	1420	2950	2350	972
	SODIUM	337	1390*	1010*	103	142	172	235	316	349*	292	379*	462*	1250*	2840*
	VANADIUM	28.39	13.7	19.7	9.53	14.6	18.2	20.8	16.9	18	9.58	15.1	21.3	18.7	11.3
	ZINC	102.8	27.1	16.7	20.6	20.1	37.1	35.3	30.5	27	13.4#	20.1	31.7	27.5	28.2

Group	Analytes	Background Concentrations	ARP-94-31C (5ft)	ARP-94-32B (3ft)	ARP-94-32C (5ft)	ARP-94-33B (3ft)	ARP-94-33C (5ft)	ARP-94-34B (3ft)	ARP-94-34C (5ft)	ARP-94-35B (3ft)	ARP-94-35C (5ft)	ARP-94-36B (3ft)	ARP-94-36C (5ft)	ARP-94-37B (3ft)	ARP-94-37C (5ft)
EXPLOSIVES	RDX	N/A	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28
METALS	ALUMINUM	28083	2530#	6830	4950	8370	5010	4780#	7150	5050	5720	4700#	4210#	6060	3410#
	ARSENIC	11.69	4.27	3.45	2.93	6.02	6.33	3.67	5.78	4.63	3.89	5.45	10	12.3*	11.2
	BARIUM	247.1	25.6#	72.8	47.6#	72.8	38#	61.1	45.7#	65.5	71.1	61.3	56.4	91.7	56.9
	BERYLLIUM	1.465	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427
	CALCIUM	114483	24300	14900	4740	19000	23000	11700	7570	21900	13800	28300	26600	21700	27300
	CHROMIUM	20.62	9.94	9.91	10.5	12.2	10.5	8.22	13.8	6.99	8.59	6.84	6.85	8.64	6.16
	COBALT	6.94	LT 2.5	2.72	2.85	3.94	3.31	3.21	4.12	2.79	3.02	3.82	3.44	3.95	4.03
	COPPER	24.72	4.74	4.92	4.51	6.55	4.79	5.45	6.04	4.47	4.71	6.14	11.8	6.3	6.62
	IRON	22731	8850	9650	9120	12100	10400	9300	12100	8710	9520	10200	10500	11700	10400
	LEAD	18.23	LT 7.44	LT 7.44	LT 7.44	11.1	LT 7.44	LT 7.44	8.95	LT 7.44	LT 7.44	8.57	11.4	LT 7.44	10.8
	MAGNESIUM	7061	3770	2830	1720	5270	4580	2470	2790	3200	2820	6100	4850	5440	4700
	MANGANESE	698.3	96.4	160	149	150	118	133	135	132	131	163	109	159	112
	MERCURY	0.0572	LT 0.05	LT 0.05	LT 0.05	0.0696*	LT 0.05	LT 0.05	0.0626*	LT 0.05	0.0776*	0.0608*	0.168*	LT 0.05	0.0853*
	NICKEL	17.4	4.74	5.39	4.32	8.48	5.76	4.84	6.39	4.06	3.72	7.94	8.65	8.14	7.78
	POTASSIUM	5449	334#	1780	1060	2040	1150	1280	1460	1410	1530	785	699#	1380	607#
	SODIUM	337	662*	142	84.4	878*	789*	151	299	109	158	484*	557*	133	67.3
	VANADIUM	28.39	15.5	16.4	14.9#	19.3	19.1	12.8#	23.6	12.3#	14.8#	12#	10.9#	18.5	11.1#
	ZINC	102.8	16.2	25.4	19.9	25	20.7	20.3	23.6	20.2	21.9	24	29.5	22.9	25.1

Table 6-45. Summary of Analytes Detected in Soil for the AED Test Range (SWMU 40) - Phase II (continued)

Subsurface Soil

Group	Analytes	Background Concentrations	ARP-94-38B (3ft)	ARP-94-38C (5ft)	ARP-94-39B (3ft)	ARP-94-39C (5ft)	ARP-94-40B (3ft)	ARP-94-40C (5ft)	ARP-94-41B (3ft)	ARP-94-41C (5ft)	ARP-94-42B (3ft)	ARP-94-42C (5ft)	ARP-94-43B (3ft)	ARP-94-43C (5ft)	ARP-94-44B (3ft)
EXPLOSIVES	RDX	N/A	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28
METALS	ALUMINUM	28083	2190#	3840#	2220#	1320#	3830#	3460#	2840#	3530#	2260#	1960#	1910#	1280#	11300
	ARSENIC	11.69	7.3	9.69	3.33	5.06	3.83	3.81	4.58	6.07	5.48	4.75	10.6	2.66	5.71
	BARIUM	247.1	61	77.5	28.5#	34.1#	49	50.7	38.2#	25.4#	38.3#	26.7#	18.9#	15.5#	143
	BERYLLIUM	1.455	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	0.628
	CALCIUM	114483	25200	37300	13200	18900	8640	18400	20300	6830	12500	18800	28700	28200	44400
	CHROMIUM	20.62	4.72	7.05	5.6	2.67	5.75	5.26	4.81	6.45	4.27	4.01	3	3.07	11.6
	COBALT	6.94	3.11	3.87	LT 2.5	LT 2.5	LT 2.5	LT 2.5	LT 2.5	2.85	LT 2.5	2.9	LT 2.5	LT 2.5	6.03
	COPPER	24.72	4.53	6.07	3.56	4.75	4.53	4.53	7.28	5.99	4.27	3.86	3.83	4.24	9.51
	IRON	22731	7230	9680	5660#	4290#	6910#	8440	8370	9080	5800#	6910#	7730	7620	15400
	LEAD	18.23	LT 7.44	7.98	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	15
	MAGNESIUM	7061	4240	5530	1850	1730	2340	2600	3370	2050	1660	2000	3110	3650	6840
	MANGANESE	698.3	132	151	49#	111	91.4#	101#	114	50.5#	53.4#	104#	69.3#	53.7#	244
	MERCURY	0.0572	0.0585*	0.0613*	LT 0.05	0.0643*	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	0.0592*	LT 0.05	0.0535	0.0583*
	NICKEL	17.4	3.9	6.21	LT 2.74	3.79	3.26	4.19	3.95	4.41	LT 2.74	5.59	4.95	4.07	10.7
	POTASSIUM	5449	459#	725#	495#	227#	974	892	818	985	550#	428#	287#	284#	3430
	SODIUM	337	317	153	279	298	231	387*	643*	730*	95.7	116	156	218	1790*
	VANADIUM	28.39	11.8#	14.1#	9.65#	6.77#	11.3#	11.8#	10.8#	13.3#	10.2#	7.66#	6.39#	7.27#	19.1
	ZINC	102.8	14.9#	23.1	11.8#	11.8#	16.8#	19.1	18.9	19.3	13#	16.9#	14.1#	12.7#	37.9

Group	Analytes	Background Concentrations	ARP-94-44C (4ft)	ARP-94-45B (3ft)	ARP-94-45C (5ft)	ARP-94-46B (3ft)	ARP-94-46C (5ft)	ARP-94-47B (3ft)	ARP-94-47C (5ft)	ARP-94-48B (3ft)	ARP-94-48C (5ft)	ARP-94-49B (3ft)	ARP-94-49B(D) (3ft)	ARP-94-49C (5ft)	ARP-94-49C(D) (5ft)
EXPLOSIVES	RDX	N/A	LT 1.28	LT 1.28	LT 1.28	LT 1.28	1.42*	LT 1.28	LT 1.28	1.69*	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28
METALS	ALUMINUM	28083	7810	8970	3660#	4500#	4860#	4640#	5260#	5320	4070#	2790#	3930#	1940#	2200#
	ARSENIC	11.69	4.45	10.4	19.5*	3.52	3.03	2.87	4.25	3.75	3.65	15.9*	8.8	6.74	3.72
	BARIUM	247.1	79.6	92.3	25.5#	32.2#	51	26.7#	43.4#	39.1#	38#	31.9#	33.9#	18#	17.5#
	BERYLLIUM	1.455	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427
	CALCIUM	114483	21900	27900	32900	12000	32400	13800	13800	7820	12300	34700	28300	45300	36300
	CHROMIUM	20.62	9.7	9.87	6.52#	8.11#	6.47#	7.5#	8.46	8.71	6.53#	4.63#	8.89	3.18#	4.57#
	COBALT	6.94	3.63	3.62	7.11*	3.55	3.07	2.77	3.57	2.93	2.81	4.05	4.06	LT 2.5	LT 2.5
	COPPER	24.72	8.01	7.45	12.6	5.54	4.32	4.06	4.7	4.85	4.85	5.26	6.97	LT 2.84	3.37
	IRON	22731	12600	12700	22700	8010#	6330#	7180#	7650#	7280#	6300#	13500	15300	6170#	6030#
	LEAD	18.23	LT 7.44	LT 7.44	15.1	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	12.4	9.48	LT 7.44	LT 7.44
	MAGNESIUM	7061	4300	5160	5600	1900	4290	2580	2510	2080	2130	7340*	3810	4470	3690
	MANGANESE	698.3	187	173	92.5#	57.9#	114#	76.3#	63.5#	74.3#	65.3#	106#	86.5#	121#	73.1#
	MERCURY	0.0572	LT 0.05	LT 0.05	LT 0.05	LT 0.05	0.0602*	LT 0.05	0.058*	0.0565	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	7.52	7.88	9.75	4.95	4.43	3.68	3.68	5.21	3.67	6.06	7.59	LT 2.74	3.39
	POTASSIUM	5449	2310	2850	822#	1060#	1220#	1150#	1380	1490	943#	617#	881#	316#	487#
	SODIUM	337	680*	413*	312	388*	280	265	392*	375*	469*	116	159	99.6	131
	VANADIUM	28.39	15.8	16.5	12.7#	16.5	10.2#	13.6#	17	15#	12.1#	10.2#	16.8#	5.18#	6.95#
	ZINC	102.8	25.4	32.7	24.1	12.7#	14.6#	15#	14.2#	15#	13.5#	17.3#	19.9#	10.9#	12#

Table 6-45. *Summary of Analytes Detected in Soil for the AED Test Range (SWMU 40) - Phase II (continued)*

Subsurface Soil

Group	Analytes	Background Concentrations	ARP-94-50B (3ft)	ARP-94-50C (5ft)	ARP-94-51B (3ft)	ARP-94-51C (5ft)	ARP-94-52B (3ft)	ARP-94-52C (5ft)	ARP-94-53B (3ft)	ARP-94-53C (5ft)	ARP-94-54B (3ft)	ARP-94-54C (5ft)	ARP-94-55B (3ft)	ARP-94-55C (5ft)	ARP-94-56B (3ft)
EXPLOSIVES	RDX	N/A	LT 1.28	LT 1.28	LT 1.28	LT 1.28	1.72*	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	NT	3.03*
METALS	ALUMINUM	28083	1820#	2960#	2540#	2230#	9910	7260	2770#	5440	5740	3100#	7250	7060	3950#
	ARSENIC	11.69	LT 2.5	LT 2.5	3.75	8.09	3.79	3.93	3.61	3.44	5.9	3.5	3.3	4.73	3.46
	BARIUM	247.1	22.7#	30.3#	16.7#	23.7#	88.1	68.6	26#	47.3#	60.8	34.2#	73.2	71.4	48.5#
	BERYLLIUM	1.455	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427
	CALCIUM	114483	36000	47800	34200	46100	17400	13100	8720	15800	34600	37400	17400	16800	18000
	CHROMIUM	20.62	4.19#	4#	3.57#	2.82#	11.4	9.53	5.26#	8.19	8.12#	5.4#	8.87	9.04	7.71#
	COBALT	6.94	LT 2.5	LT 2.5	LT 2.5	LT 2.5	3.76	3.35	LT 2.5	LT 2.5	4.37	4.2	2.81	2.93	2.84
	COPPER	24.72	4.31	3.59	16.5	3.7	9.18	9.7	5.73	5.04	6.58	7.81	5.75	6.14	4.86
	IRON	22731	6450#	6920#	9020	7140#	11600	9940	7410#	9560	12500	11100	9610	9760	7160#
	LEAD	18.23	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	8.2	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44
	MAGNESIUM	7061	1700	2840	4160	2730	4700	3580	1860	3100	4650	3510	3160	3500	2790
	MANGANESE	698.3	56.8#	72.2#	94.3#	89.5#	197	150	67.7#	100#	138	109#	149	149	72#
	MERCURY	0.0572	LT 0.05	LT 0.05	LT 0.05	LT 0.05	0.0524	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	NICKEL	17.4	4.09	3.93	6.94	4.79	7.17	5.89	4.3	5.36	9.06	7.12	5.11	6.07	4.62
	POTASSIUM	5449	338#	703#	400#	491#	3200	2160	623#	1310#	1530	743#	2000	1970	784#
	SODIUM	337	217	168	75.3	96.1	544*	621*	168	399*	251	123	175	178	179
	VANADIUM	28.39	8.81#	5.56#	6.14#	6.23#	18.5	18.5	10.2#	15.7#	13.5#	9.44#	15.4#	15.6#	13.5#
	ZINC	102.8	12.2#	11#	16.9#	12#	33.2	24.2	14.8#	19.4#	27	22.6#	25.4	25.2	15.5#

Group	Analytes	Background Concentrations	ARP-94-56C (5ft)	ARP-94-57B (3ft)	ARP-94-57C (5ft)	ARP-94-58B (3ft)	ARP-94-58C (5ft)	ARP-94-59B (3ft)	ARP-94-59C (5ft)	ARP-94-60B (3ft)	ARP-94-60C (5ft)	ARB-95-01B (2ft)	ARB-95-02B (2ft)	ARB-95-03B (2ft)	ARB-95-04B (1ft)
EXPLOSIVES	RDX	N/A	2.09*	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28
METALS	ALUMINUM	28083	2860#	6680	5600	7360	5000#	6230	3660#	9930	3110#	NT	NT	NT	NT
	ARSENIC	11.69	4.4	3.72	3.48	4.99	29.3*	4.68	4.87	13.3*	4.38	NT	NT	NT	NT
	BARIUM	247.1	30.1#	70.2	54.7	84.4	45.7#	62.1	30.1#	144	36.5#	NT	NT	NT	NT
	BERYLLIUM	1.455	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	NT	NT	NT	NT
	CALCIUM	114483	18300	17900	7480	33100	52700	12100	8980	93000	17300	NT	NT	NT	NT
	CHROMIUM	20.62	10.3	7.83	9.89	8.47	6.78	10.2	5.64#	11.5	5.96	NT	NT	NT	NT
	COBALT	6.94	2.8	2.78	3.38	LT 2.5	3.36	3.35	LT 2.5	5.98	LT 2.5	NT	NT	NT	NT
	COPPER	24.72	4.38	4.56	6.64	6.91	5.48	5.4	LT 2.84	7.96	3.66	NT	NT	NT	NT
	IRON	22731	9930	8940	9870	9880	9920	9310	4710#	14100	6800#	NT	NT	NT	NT
	LEAD	18.23	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	LT 7.44	NT	NT	NT	NT
	MAGNESIUM	7061	2500	3230	2550	4280	5770	2100	1810	8790*	4700	NT	NT	NT	NT
	MANGANESE	698.3	92#	151	128	159	108#	106#	67.8#	206	95.2#	NT	NT	NT	NT
	MERCURY	0.0572	0.0815*	LT 0.05	LT 0.05	LT 0.05	0.0724*	LT 0.05	0.106*	0.074*	LT 0.05	NT	NT	NT	NT
	NICKEL	17.4	5.57	4.63	5.29	4.94	6.12	4.18	LT 2.74	10.8	3.4	NT	NT	NT	NT
	POTASSIUM	5449	645#	1790	1500#	1990	1130#	1560	1090#	2450	697#	NT	NT	NT	NT
	SODIUM	337	84.1	159	241	175	200	194	247	2450*	725*	NT	NT	NT	NT
	VANADIUM	28.39	20.3	13.2#	22.6	15.9#	12.7#	18.3	8.95#	18.6	10.9#	NT	NT	NT	NT
	ZINC	102.8	20.2#	22.9	21.2	26.7	20.1	19.2#	10.2#	28.7	14.5#	NT	NT	NT	NT
ANIONS	SULFATE	N/A	NT	NT	NT	NT	NT	NT	NT	NT	NT	LT 5	5.62*	LT 5	LT 5

Table 6-45. *Summary of Analytes Detected in Soil for the AED Test Range (SWMU 40) - Phase II (continued)*

Subsurface Soil

Group	Analytes	Background Concentrations	ARB-95-05B (2ft)	ARP-95-01B (3ft)	ARP-95-01C (5ft)	ARP-95-02B (3ft)	ARP-95-02C (5ft)	ARP-95-03B (3ft)	ARP-95-03C (5ft)	RP-95-03C(D) (5ft)
EXPLOSIVES	RDX	N/A	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28	LT 1.28
METALS	ALUMINUM	28083	NT	NT	NT	NT	NT	NT	NT	NT
	ARSENIC	11.69	NT	NT	NT	NT	NT	NT	NT	NT
	BARIUM	247.1	NT	NT	NT	NT	NT	NT	NT	NT
	BERYLLIUM	1.455	NT	NT	NT	NT	NT	NT	NT	NT
	CALCIUM	114483	NT	NT	NT	NT	NT	NT	NT	NT
	CHROMIUM	20.62	NT	NT	NT	NT	NT	NT	NT	NT
	COBALT	6.94	NT	NT	NT	NT	NT	NT	NT	NT
	COPPER	24.72	NT	NT	NT	NT	NT	NT	NT	NT
	IRON	22731	NT	NT	NT	NT	NT	NT	NT	NT
	LEAD	18.23	NT	NT	NT	NT	NT	NT	NT	NT
	MAGNESIUM	7061	NT	NT	NT	NT	NT	NT	NT	NT
	MANGANESE	698.3	NT	NT	NT	NT	NT	NT	NT	NT
	MERCURY	0.0572	NT	NT	NT	NT	NT	NT	NT	NT
	NICKEL	17.4	NT	NT	NT	NT	NT	NT	NT	NT
	POTASSIUM	5449	NT	NT	NT	NT	NT	NT	NT	NT
	SODIUM	337	NT	NT	NT	NT	NT	NT	NT	NT
	VANADIUM	28.39	NT	NT	NT	NT	NT	NT	NT	NT
	ZINC	102.8	NT	NT	NT	NT	NT	NT	NT	NT
ANIONS	SULFATE	N/A	LT 5	NT	NT	NT	NT	NT	NT	NT

Note.- All values in $\mu g/g$ (equal to ppm).
N/A = Not Applicable.
LT = Analyte concentration is less than CRL, the CRL is posted next to the "LT".
NT = Not Tested.
* = Organic analyte detected above CRL or MDL or detected inorganic analyte exceeding background.
(D) = Duplicate analysis.
\# = Analyte was detected in the associated blank in excess of the 5 or 10 times rule (as described in Section 3.1.1.1).
† = Anions, cyanide, ethylcentralite, and SVOCs analyzed for in only 1995 Phase II boreholes.

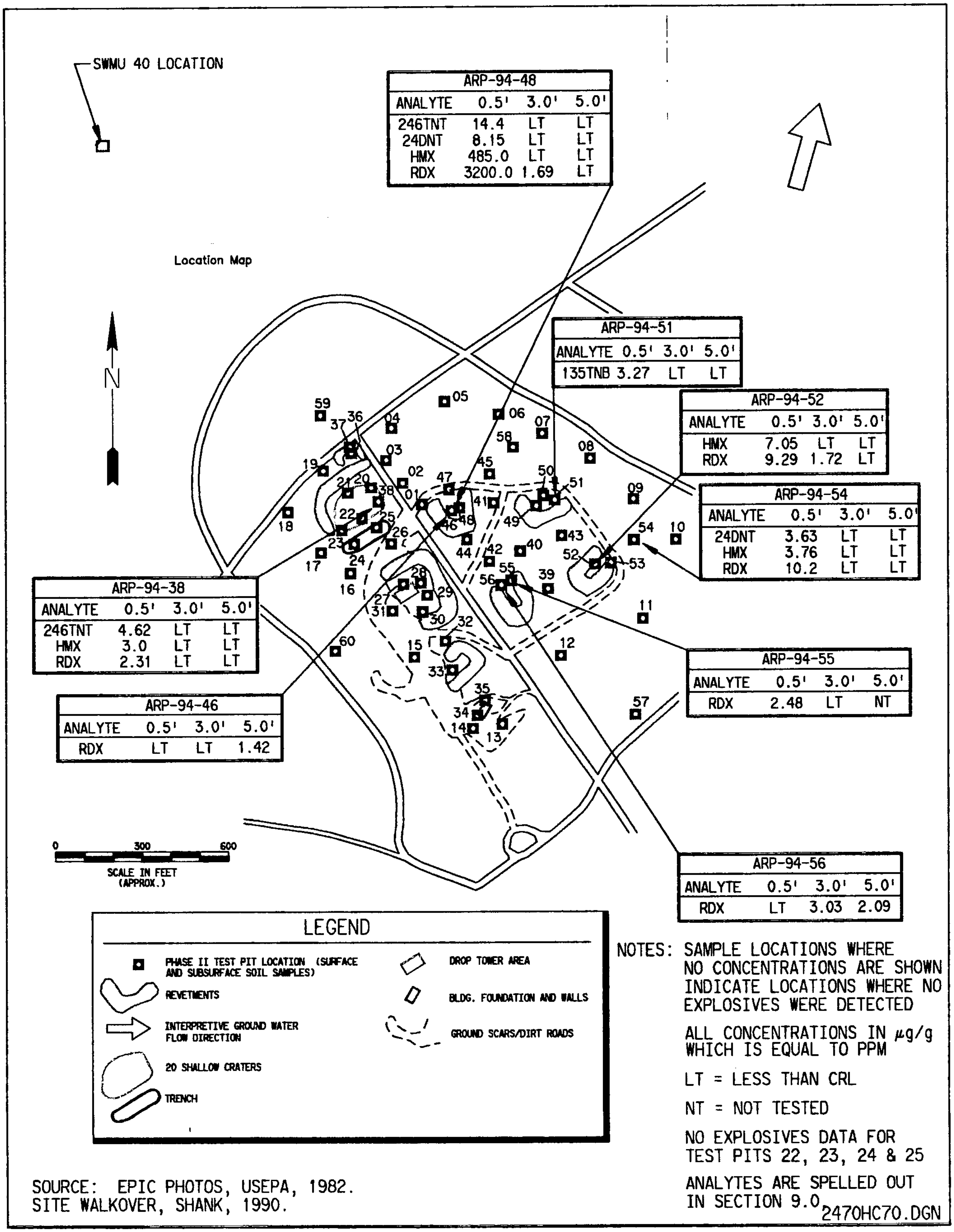

Figure 6-13. SWMU 40 Phase II Explosives Results

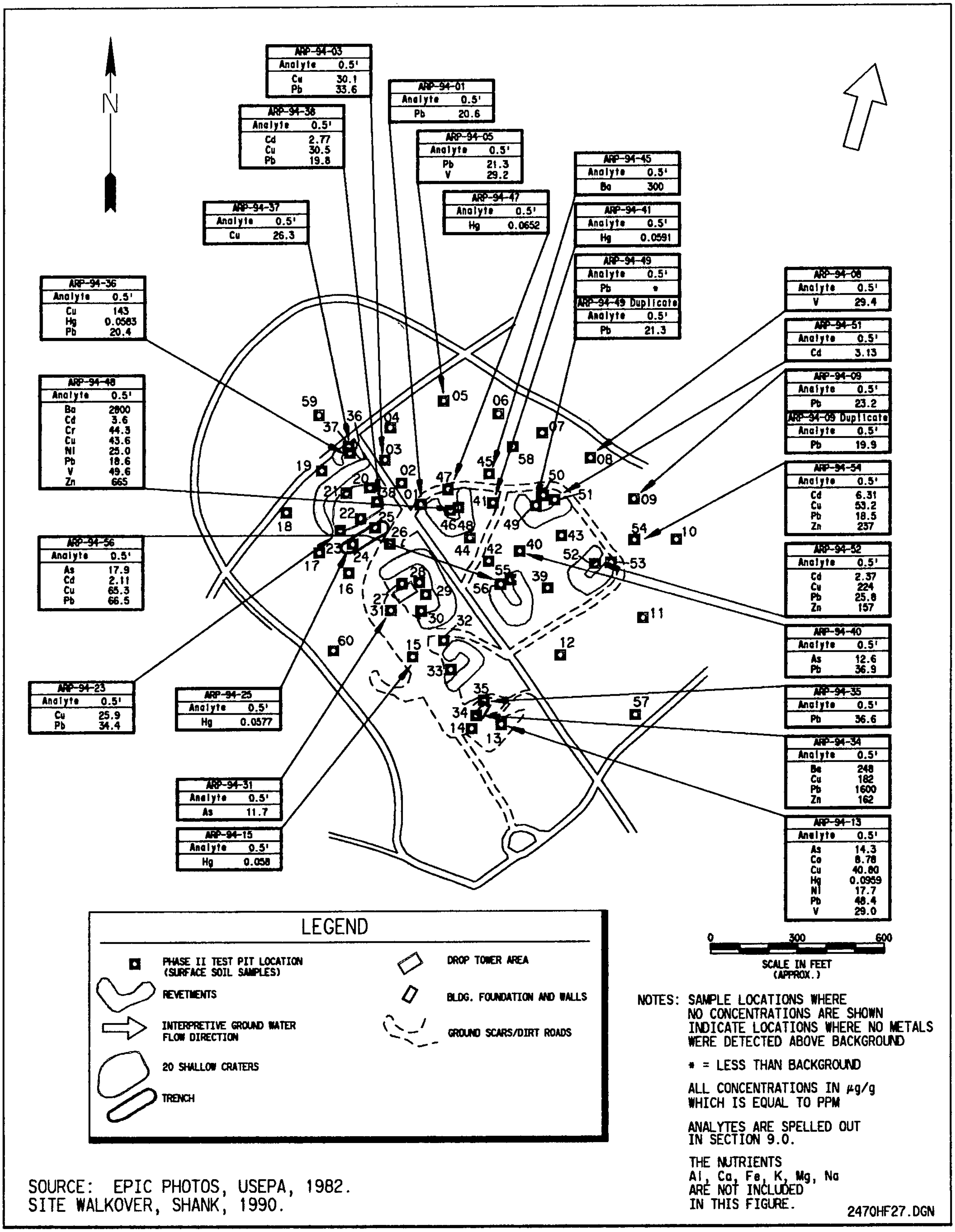

Figure 6-14. SWMU 40 Phase II Metals Results for Surface Soils

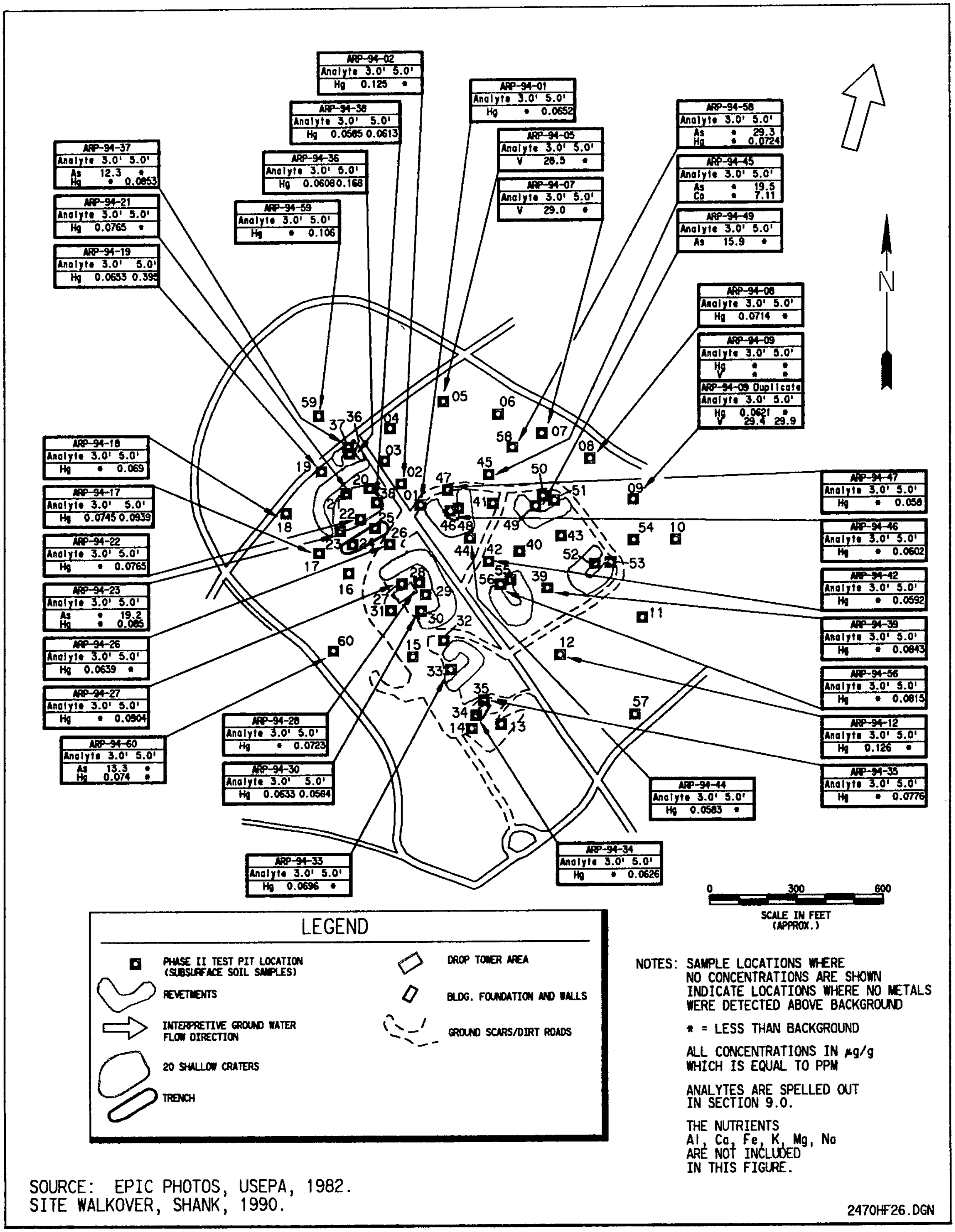

Figure 6-15. SWMU 40 Phase II Metals Results for Subsurface Soils

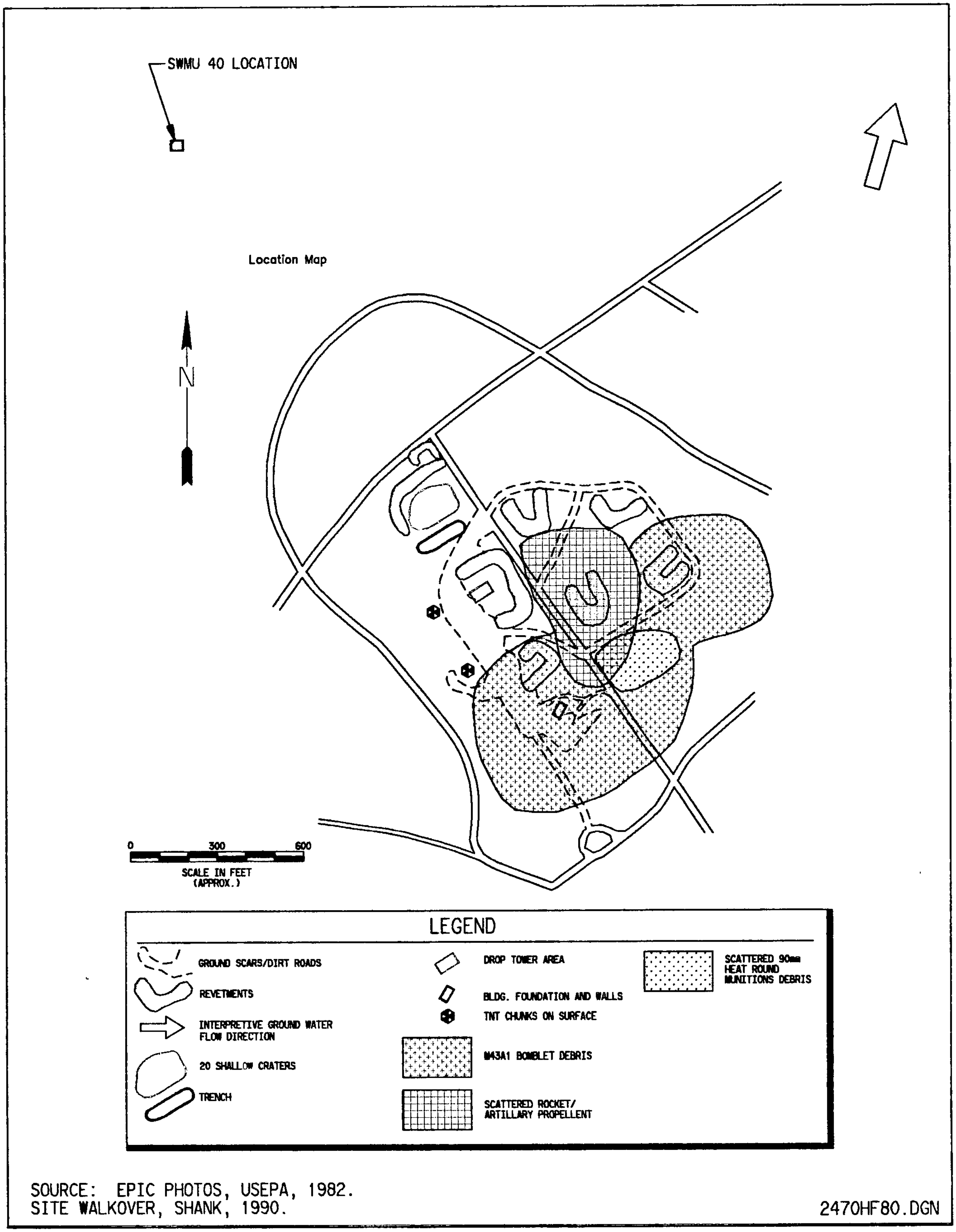

Figure 6-16. SWMU 40 Phase II Distribution of Major Types of Debris

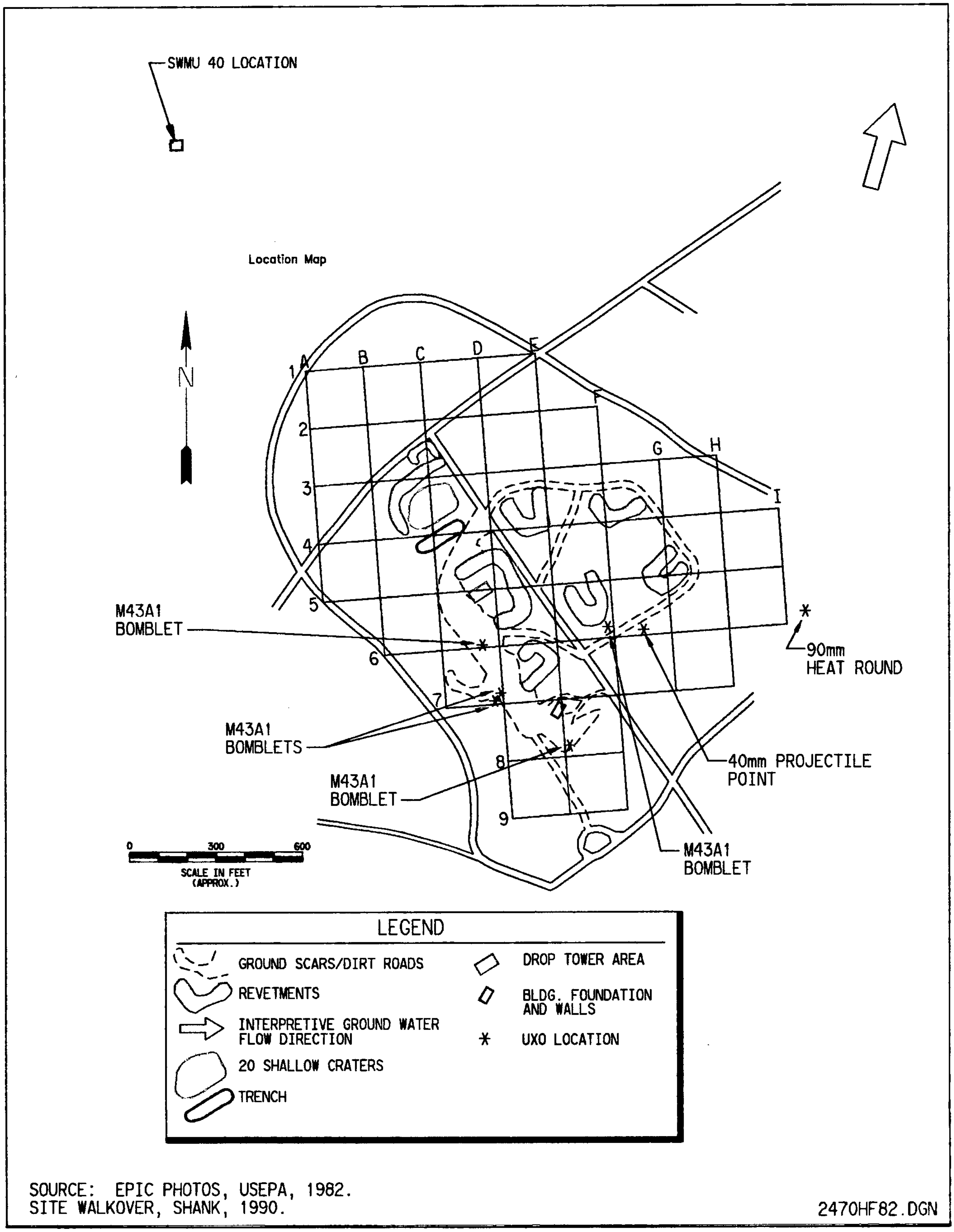

Figure 6-17. SWMU 40 UXO Device Locations

Table 6-46. Common Propellant Types (Nominal Compositions)

Model Designation	M1	M2	M5	M6	M7	M9	M9	M10	M12	M13	M14	M15	M16	M17	M18	DMR
Composition Percent (Weapon Use)	A[a]	A	A	A	R[b]	M[c]	M	RR[d]	S[e]	R	A	A	R	A	S	S
Nitrocellulose	85.0	77.45	81.95	87.0	54.6	52.15	57.75	98.00	97.70	57.3	90.00	20.0	55.5	22.0	80.00	100.00
Nitroglycerin		19.50	15.00		35.5	43.00	40.00			40.00		19.0	27.5	21.5	10.0	
Nitroguanidine												54.7		54.7		
Dinitrotoluene	10.0			10.0					8.0 Coat		8.0		10.5			8.0 Coat
Dibutylphthalate	5.0			3.0							2.0				9.0	
Diethylphthalate						3.00										
Diphenylamine	1.0			*1.0				1.0	0.8	0.2	*1.0			1.00	*0.7	
Ethyl Centralite		.60	0.60		0.9	0.60	0.75			1.0		6.0	4.0	1.5		
Barium Nitrate		1.40	1.40													
Potassium Nitrate		0.75	0.75			1.25	1.50									
Potassium Perchlorate					7.8											
Potassium Sulfate								1.0	0.75	1.5			1.5			*1.00
Tin									0.75							
Carbon Black					1.2					0.05(Coat)			0.50			
Graphite		0.30	0.30					0.1 Glaze						0.1 Glaze		
Cryolite												0.3		0.3		
Lead Stearate													0.5			
Nitrodiphenyldianine																
Coating																

[a]A= Artillary.
[b]R= Rockets.
[c]M= Mortare.
[d]S= Small arms.
[e]Recoilless rifle.

Table 6-46. *Common Propellant Types (Nominal Compositions) (continued)*

Model Designation	M22	M26	T2	T25	T29 E1	M31 T34	M30 T36	M30E1 T36E1	Type I Single Base			Type II Double Base		
Composition Percent (Weapon Use)	R	T24 RR	R	RR	A	A	A	A	C1.1 Flake	C1.2 Cylinder	C1.3 Bell & B. Mod.	C1.1 Flake	C1.2 Cylinder	C1.3 Bell & B. Mod.
Nitrocellulose		67.25	57.50	73.25	68.70	20.00	26.00	28.00	98.30	98.30	98.50	82.00	77.00	89.30
Nitroglycerin		25.00	30.00	20.00	25.00	19.00	22.50	22.50				13.00	20.00	9.00
Nitroguanidine						54.70	47.70	47.00						
Dinitrotoluene			2.50											
Dibutylphthalate						4.50								
Sodium Sulphate											0.15			0.15
Diphenylamine									0.70	0.70	0.70	0.75	0.75	0.90
Ethyl Centralite		6.00	8.00	5.00	6.00		1.50	1.50						
Barium Nitrate		0.75		0.75								1.50	1.50	
Potassium Nitrate	x	0.70		0.70								0.50	0.50	
Calcium Carbonate											0.65			0.65
Calcium Stearate	x													
Ethyl Cellulose	x													
Amonium Picrate	x													
Carbon Black			*0.02				0.20							
Graphite		0.30		0.30	0.30	0.1 (Glaze)	0.1* (Glaze)					0.25	0.25	
Cryolite					0.30	0.30								
Lead Stearate			0.50											
2-Nitrodiphenyldiamine					1.50			1.00						
Coating	Chlor. Wax													
Potassium Sulfate			1.50					1.00						

Note.—Usual coating is DNT but may be ethyl centralite or dibutylphthalate. CI.3 may be coated with Flash inhibiting salt (i.e., potassium sulfate or potassium Nitrate). Type I and Type II are small arms propellant types.

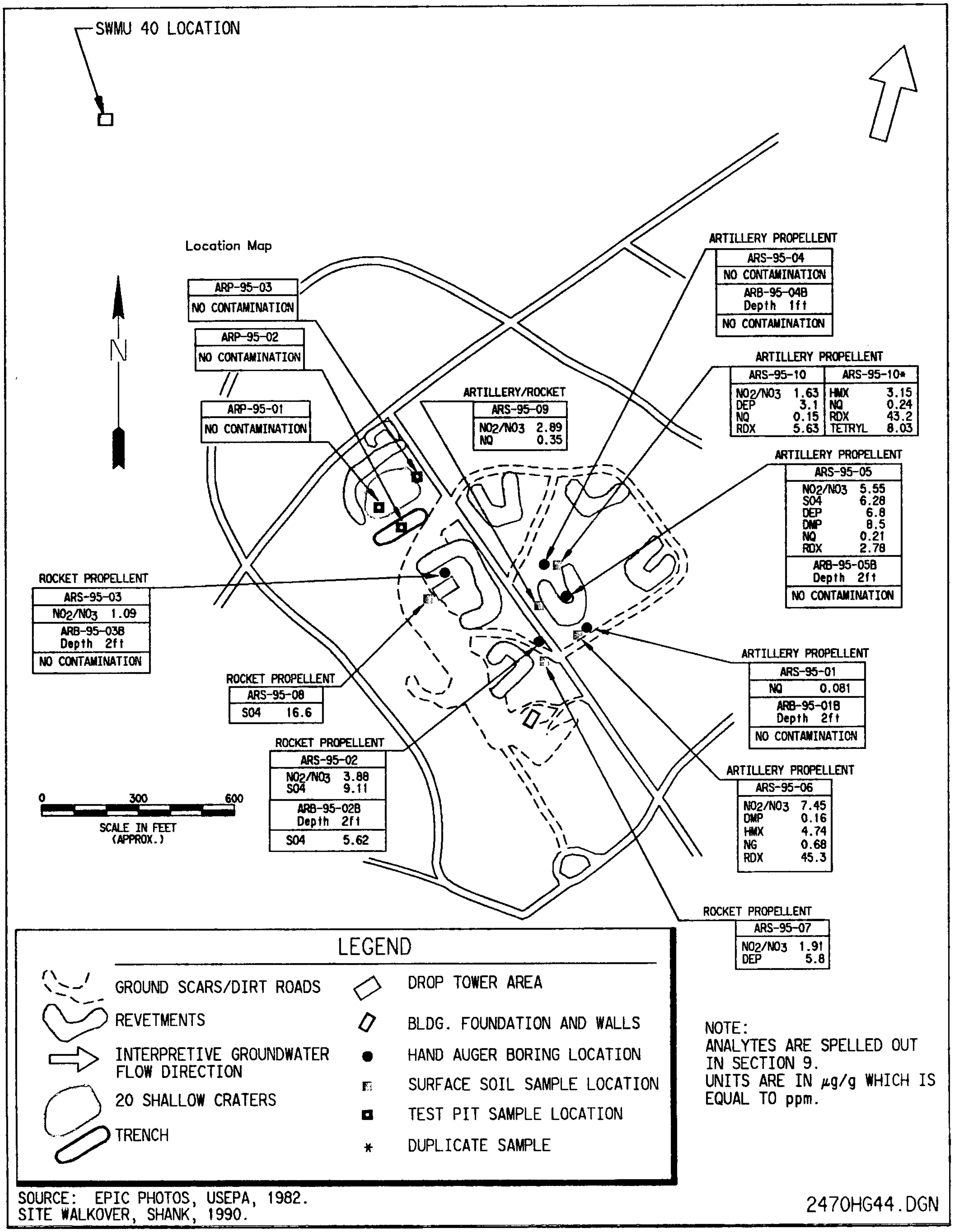

Figure 6-18. SWMU 40 Phase II Propellant Sample Locations and Results

The primary component of propellant is nitrocellulose (from 20 to 100 percent, depending on propellant type (see Table 6-46)). A colorimetric analytical method was utilized for the analysis of nitrocellulose in SWMU 40 soil samples. Although detections of nitrocellulose were reported in all 15 soil samples associated with propellant fragments, problems with corresponding blank contamination and MS/MSD recoveries occurred. As a result, personnel performing data validation recommended the data be rejected when using USEPA functional guidelines for evaluating data quality. Reported conentrations ranged form 63.9 to 180 μg/g; however, method blank contamination was reported at 87 μg/g. Rust E&I requested the samples be re-run; the second set of results were similar to the first set of analyses in that the blanks values exceeded the CRLs. It should be noted that nitrocellulose is highly reactive upon exposure to air and will decompose rapidly in the environment if its protective coating is absent. According to the analytical laboratory personnel responsible for this analysis, nitrocellulose is extremely sticky and adheres to the analytical glassware. Nitrocellulose is a large molecule and, as such, it is expected to strongly adsorb to soil particles; therefore, migration is unlikely.The samples collected in test pits located adjacent to previous Phase II RI test pits where explosives data were rejected, did not contain explosives contaminants.

In summary, potential explosive and burning hazards still exist at SWMU 40 as a result of UXO and propellant fragments present in surface soils. Additional cleanup of these materials would be required before the property could be releaseed for other land use. Other contaminants present in surface and subsurface soils from previous testing activities at SWMU 40 are primarily concentrated in the individual revetment areas as shown on Figures 6-14, 6-14, and 6-15.

6.2.4 Human Health Risk Assessment

As part of the Phase II RI, an RA was conducted to estimate potential human health risks associated with the no-action alternative for SWMU 40, the AED Test Range. The following tasks were completed in the RA:

- Data analysis and selection of COPCs
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Conclusions and recommendations

This section provides a summary of the quantitative process employed at SWMU 40 and the results of that process. The RA for SWMU 40 is based on the methodology described in Section 3.1 and supported by Appendices L, M, N, and O.

6.2.4.1 ***Selection of Chemicals of Potential Concern for Soils.*** As detailed in USEPA guidance (USEPA 1989a, USEPA 1994), a screening procedure can be used to narrow the list of contaminants at a particular site to a subset of analytes that can be considered the COPCs

for the area. This screening procedure can involve up to four steps, depending on the contaminants present:

- Group data by chemical class (e.g., carcinogenic PAHs)
- Evaluate frequency of detection
- Evaluate essential nutrients
- Compare site data to risk-based screening concentrations (Region III values)

Below is the screening analysis for SWMU 40.

6.2.4.1.1 ***Data Grouping.*** No data grouping was necessary as part of COPC selection at SWMU 40.

6.2.4.1.2 ***Frequency of Detection.*** The explosives 2,4-dinitrotoluene, 2,6-dinitrotoluene, 2,4,6-trinitrotoluene, RDX, and HMX were detected in fewer than 5 percent of total samples in either surfrace or subsurface soil. However, because explosives were expected to be present at this site, these compounds were retained as potential COPCs.

6.2.4.1.3 ***Nutrient Screening.*** All of the nutrients detected above background in surface soil had maximum detected values that were less than their respective nutrient screening values: calcium (maximum—140,000 μg/g; screening value—1,000,000 μg/g), iron (maximum—23,200 μg/g; screening value—70,000 μg/g), magnesium (maximum—51,800 μg/g; screening value—1,000,000 μg/g), potassium (maximum—6,300 μg/g; screening value—150,000 μg/g), and sodium (maximum—9,970 μg/g; screening value—1,000,000 μg/g). Therefore, these nutrients were eliminated as COPCs in surface soil.

All of the nutrients detected above background in subsurface soil also had maximum detected values that were less than their respective nutrient screening values: magnesium (maximum—11,000 μg/g; screening value—1,000,000 μg/g), potassium (maximum—6,100 μg/g; screening value—150,000 μg/g), and sodium (maximum—3,150 μg/g; screening value—1,000,000 μg/g). Therefore, these nutrients were eliminated as COPCs in subsurface soil.

6.2.4.1.4 ***Region III RBC Screening.*** The final step in the COPC selection process consisted of comparing the EPCs for remaining contaminants in surface and subsurface soil with Region III RBCs. However, before these comparisons were made, a "hot spot" analysis was conducted.

For the final selection of COPCs, the site was evaluated for possible "hot spots." Samples from two areas with obviously high concentrations of contaminants were segregated as potential hot spots: an area with high explosives in the vicinity of test pit ARP-94-48, and an area with high lead near the old furnace building (in the vicinity of test pit ARP-94-34). The

samples selected for inclusion in these hot spots were those within a roughly 0.5-acre area around the highest chemical concentrations.

The following samples were included in the evaluation of the potential hot spot in the vicinity of test pit ARP-94-48: ARS-92-R31, ARP-94-01, - 41, -44, -46, -47, and 48, and ARS-95-09 (a total of 8 surface samples and 12 subsurface samples)

The following samples were included in the evaluation of the potential hot spot near the old furnace building: ARS-92-B01 through -B04 and ARP-94-13, -14, -34, and -35 (a total of eight surface samples and eight subsurface samples).

All other samples were combined to evaluate the remainder of the site. Table 6-47 provides a summary of the EPCs for preliminary COPCs in surface and subsurface soil at the designated areas of concern at SWMU 40.

To select COPCs for the soils, the EPCs for the areas of concern within the site in surface and subsurface soil were compared to Region III soil ingestion and soil-to-air RBCs. As shown in Table 6-48, at the hot spot near the old furnace building, arsenic and lead were selected as COPCs in surface soil. There were no COPCs in subsurface soil in this area of concern. At the hot spot in the vicinity of test pit ARP-94-48, barium, HMX, and RDX were selected COPCs in surface soil; in subsurface soil in this area, no chemicals were selected as COPCs. For the remainder of the site, arsenic and 1,3,5-trinitrobenzene were selected as COPCs in surface soil, and arsenic was selected as a COPC in subsurface soil.

6.2.4.1.5 *Site-wide Soils.* Concentrations of the COPCs for surface soils—arsenic, barium, lead, 1,3,5-trinitrobenzene, HMX, and RDX—were calculated on a site-wide basis for the purpose of evaluating site-wide exposure scenarios. Site-wide concentrations were calculated utilizing all surface soil samples collected at SWMU 40. The site-wide concentrations of these surface soil COPCs are provided in Table 6-49.

6.2.4.2 *Selection of Chemicals of Potential Concern for Groundwater*

The selection of COPCs for the groundwater exposure pathways consist of a two-phase modeling approach. Initially, the *maximum* concentration of each analyte detected in either surface or subsurface soil was compared to the Region III soil-to-groundwater RBC. One-tenth of the value was used for noncarcinogens. If the maximum concentration of a chemical exceeded the soil-to-groundwater RBC, the chemical was selected for vadose zone modeling (Table 6-50). The modeled break-through concentration in groundwater for these chemicals was then compared to the Region III tap water RBCs, with one-tenth of the value used for noncarcinogens. In addition, the modeled break-through time was compared to the 100-year cut-off period as described in Section 2.7.2. A chemical that reached the water table within 100 years *and* had a modeled break-through concentration that exceeded the Region III tap

Table 6-47. *Summary of Preliminary Chemicals of Potential Concern (SWMU 40)*

Chemical	Frequency of Detection[a]	Range of Detected Values (μg/g)	Range of Reporting Limits (μg/g)	Arithmetic Mean Concentration (μg/g)	95% UCL Concentration (μg/g)	Exposure Point Concentration[b] (μg/g)
Hot Spot Near Old Furnace Building - Surface Soil						
Arsenic	4/8	6.89 - 14.3	24.0	10.9	12.7	12.7
Barium	8/8	73.4 - 248	NA	118	179	179
Cadmium	1/8	4.60	0.424 - 1.20	0.809	3.59	3.59
Cobalt	3/4	3.0 - 8.78	2.50	4.1	54.5	8.78
Copper	8/8	7.54 - 182	NA	48.9	447	182
Lead	8/8	18.0 - 1,600	NA	403	13,333	1,600
Mercury	1/8	0.096	0.026 - 0.05	0.026	0.055	0.055
Nickel	4/8	5.23 - 17.7	2.46	5.08	24.6	17.7
Nitrate	3/4	4.34 - 7.04	3.36	4.79	29.3	7.04
Vanadium	2/4	18.7 - 29.0	2.99	13.4	3.4E+05	29.0
Zinc	8/8	29.4 - 180	NA	72.7	169	169
Hot Spot Near Old Furnace Building - Subsurface Soil						
Mercury	2/8	0.063 - 0.078	0.05	0.036	0.055	0.055
Hot Spot in Vicinity of ARP-94-48 - Surface Soil						
Barium	7/7	58.0 - 2,800	NA	300	4,826	2,800
Cadmium	1/7	3.60	0.424 - 1.20	0.892	3.06	3.10
Chromium	7/7	6.71 - 44.3	NA	15.6	35.0	35.0
Copper	7/7	7.11 - 43.6	NA	14.1	30.5	30.5
Lead	5/7	16.3 - 42.0	7.44	18.1	77.0	42.0
Mercury	2/7	0.059 - 0.065	0.026 - 0.05	0.034	0.064	0.064
Nickel	6/6	5.34 - 25.0	NA	9.57	20.5	20.5
Nitrate	1/2	2.89	3.36	2.28	NA	2.28
Vanadium	4/6	17.7 - 49.6	2.99	24.1	2,306	49.6
Zinc	7/7	28.1 - 665	NA	97.5	629	629
2,4-Dinitrotoluene	1/8	8.15	0.39 - 2.5	1.80	8.0	8.0
2,4,6-Trinitrotoluene	1/8	14.4	0.931 - 2.0	1.96	8.68	8.68
HMX	2/8	1.49 - 485	2.0	13.0	5,668	485
Nitroguanidine	1/1	0.35	NA	NA	NA	0.35
RDX	1/8	3,200	0.445 - 1.28	37.4	3.8E+07	3,200

Table 6-47. *Summary of Preliminary Chemicals of Potential Concern (SWMU 40) (continued)*

Chemical	Frequency of Detection[a]	Range of Detected Values (μg/g)	Range of Reporting Limits (μg/g)	Arithmetic Mean Concentration (μg/g)	95% UCL Concentration (μg/g)	Exposure Point Concentration[b] (μg/g)
Hot Spot in Vicinity of ARP-94-48 - Subsurface Soil						
Mercury	5/12	0.057 - 0.065	0.05	0.039	0.053	0.053
RDX	2/12	1.42 - 1.69	1.28	0.783	0.973	0.973
Remainder of Site - Surface Soil						
Arsenic	50/56	2.54 - 17.9	24.0 - 240	9.03	11.4	11.4
Barium	56/56	43.0 - 300	NA	104	112	112
Cadmium	6/56	1.42 - 6.31	0.42 - 1.20	0.766	0.902	0.902
Copper	56/56	5.65 - 224	NA	20.6	25.4	25.4
Lead	51/56	8.11 - 130	7.44	16.2	19.5	19.5
Mercury	3/56	0.0577 - 0.0583	0.03 - 0.05	0.025	0.027	0.027
Nitrate	10/15	1.09 - 11.2	1.0 - 3.36	3.66	8.41	8.41
Silver	6/56	0.048 - 0.930	0.80	0.406	0.460	0.460
Vanadium	39/50	14.4 - 29.4	2.51 - 3.56	21.0	31.2	29.4
Zinc	56/56	17.5 - 237	NA	53.4	61.1	61.1
1,3,5-Trinitrobenzene	1/60	3.27	0.35 - 0.92	0.468	0.513	0.513
2,4-Dinitrotoluene	2/64	1.41 - 3.63	0.39 - 2.50	1.18	1.34	1.34
2,4,6-Trinitrotoluene	2/64	4.62 - 6.84	0.93 - 2.0	1.07	1.16	1.16
Diethyl phthalate	4/15	0.939 - 6.80	0.240 - 0.330	0.878	4.69	4.69
Dimethyl phthalate	2/15	0.160 - 8.50	0.063 - 0.330	0.261	1.24	1.24
Di-n-butyl phthalate	1/15	0.167	0.330 - 1.30	0.469	0.734	0.167
HMX	7/64	3.0 - 7.05	0.76 - 20.0	1.38	1.61	1.61
Nitroguanidine	3/9	0.081 -0.235	0.045	0.067	0.251	0.235
RDX	9/64	1.45 - 45.3	0.45 - 1.28	1.53	2.14	2.14
Tetryl	1/64	8.03	1.04 - 2.11	1.08	1.16	1.16
Remainder of Site - Subsurface Soil						
Arsenic	98/105	2.66 - 29.3	2.50 - 72.0	6.9	7.57	7.57
Cobalt	77/100	2.72 - 7.11	2.50	3.2	3.49	3.49
Copper	103/104	3.14 - 180	2.84	7.82	8.60	8.60
Lead	39/105	2.5 - 51.0	7.44	6.29	7.0	7.0
Mercury	33/105	0.031 - 0.395	0.03 - 0.05	0.041	0.046	0.046

Table 6-47. *Summary of Preliminary Chemicals of Potential Concern (SWMU 40) (continued)*

Chemical	Frequency of Detection[a]'	Range of Detected Values (µg/g)	Range of Reporting Limits (µg/g)	Arithmetic Mean Concentration (µg/g)	95% UCL Concentration (µg/g)	Exposure Point Concentration[b] (µg/g)
Remainder of Site - Subsurface Soil (continued)						
Nitrate	1/10	115	1.0 - 3.36	4.33	74.3	74.3
Silver	4/105	0.02 - 0.77	0.01 - 0.80	0.432	0.490	0.490
Vanadium	67/100	8.89 - 29.9	2.99 - 3.56	15.6	21.1	21.1
2,4-Dinitrotoluene	1/107	2.91	0.39 - 2.50	1.23	1.31	1.31
2,4,6-Trinitrotoluene	1/107	2.86	0.93 - 2.0	1.0	1.0	1.0
HMX	1/107	2.37	0.76 - 2.0	0.991	1.03	1.03
RDX	5/107	0.808 - 34.0	0.45 - 1.28	0.746	0.814	0.814
Tetryl	1/107	18.0	1.04 - 2.11	1.11	1.17	1.17

Note.—Range of reporting limits presents CRLs for nondetects only in order to show range of values used to calculated EPCs (1/2 the CRL). An NA means that there were no nondetects for a particular analyte.

[a]Number of samples in which the analyte was detected/total number of samples analyzed.

[b]The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).

[c]Not applicable.

Table 6-48. Selection of Chemicals of Potential Concern for Soil-related Pathways Based on EPA Region III's RBCs (SWMU 40)

	EPA Region III RBC Screen			
	Residential RBCs (μg/g)			
Chemical	Ingestion	Inhalation	Exposure Point Conc. (μg/g)	Retained as COPC?
Hot Spot Near Old Furnace Building - Surface Soil				
Arsenic	0.43	380	12.7	**YES**
Barium	550	35,000	179	No
Cadmium	3.9	920	3.59	No
Cobalt	470	NA	8.78	No
Copper	310	NA	182	No
Lead	400[a]	NA	1,600	**YES**
Mercury	2.3	0.7	0.055	No
Nickel	160	6,900	17.7	No
Nitrate	13,000	NA	7.04	No
Vanadium	55	NA	29.0	No
Zinc	2,300	NA	169	No
Hot Spot Near Old Furnace Building - Subsurface Soil				
Mercury	2.3	0.7	0.055	No
Hot Spot in Vicinity of Test Pit ARP-94-48 - Surface Soil				
Barium	550	35,000	2,800	**YES**
Cadmium	3.9	920	3.1	No
Chromium	39.0	140	35.0	No
Copper	310	NA	30.5	No
Lead	400[a]	NA	42.0	No
Mercury	2.3	0.7	0.064	No
Nickel	160	6,900	20.5	No
Nitrate	13,000	NA	2.28	No
Vanadium	55	NA	49.6	No
Zinc	2,300	NA	629	No
2,4-Dinitrotoluene	16.0	12.0	8.0	No
2,4,6-Trinitrotoluene	21.0	NA	8.68	No
HMX	390[a]	NA	485	**YES**
Nitroguanidine	780	NA	0.35	No
RDX	5.8[a]	NA	3,200	**YES**
Hot Spot in Vicinity of Test Pit ARP-94-48 - Subsurface Soil				
Mercury	2.3	0.7	0.053	No
RDX	5.8[a]	NA	0.973	No
Remainder of Site - Surface Soil				
Arsenic	0.43	380	11.4	**YES**
Barium	550	35,000	112	No

Table 6-48. Selection of Chemicals of Potential Concern for Soil-related Pathways Based on EPA Region III's RBCs (SWMU 40) (continued)

	EPA Region III RBC Screen			
	Residential RBCs (µg/g)			
Chemical	Ingestion	Inhalation	Exposure Point Conc. (µg/g)	Retained as COPC?
Remainder of Site - Surface Soil (continued)				
Cadmium	3.9	920	0.902	No
Copper	310	NA	25.4	No
Lead	400[a]	NA	19.5	No
Mercury	2.3	0.7	0.027	No
Nitrate	13,000	NA	8.41	No
Silver	39.0	NA	0.460	No
Vanadium	55.0	NA	29.4	No
Zinc	2,300	NA	61.1	No
1,3,5-Trinitrobenzene	0.39	NA	0.513	YES
2,4-Dinitrotoluene	16.0	12.0	1.34	No
2,4,6-Trinitrotoluene	21.0	NA	1.16	No
Diethyl phthalate	6,300	52	4.69	No
Dimethyl pthalate	78,000	160	1.24	No
Di-n-butyl phthalate	780	10	0.167	No
HMX	390[a]	NA	1.61	No
Nitroguanidine	780	NA	0.235	No
RDX	5.8[a]	NA	2.14	No
Tetryl	78	NA	1.16	No
Remainder of Site - Subsurface Soil				
Arsenic	0.43	380	7.57	YES
Cobalt	470	NA	3.49	No
Copper	310	NA	8.60	No
Lead	400[a]	NA	7.0	No
Mercury	2.3	0.7	0.046	No
Nitrate	13,000	NA	74.3	No
Silver	39.0	NA	0.490	No
Vanadium	55.0	NA	21.1	No
2,4-Dinitrotoluene	16.0	12.0	1.31	No
2,4,6-Trinitrotoluene	21.0	NA	1.0	No
HMX	390[a]	NA	1.03	No
RDX	5.8[a]	NA	0.814	No
Tetryl	78	NA	1.17	No

Note.—RBCs were taken directly from the Region III RBC Table (US EPA, 1995), except as noted in the footnotes. Values for noncarcinogens are 1/10 of the Region III RBC.

[a]OSWER recommended clean-up level for lead in residential soil (USEPA, 1994).

[b]Calculated according to Region III guidance (USEPA, 1995).

NA = Not applicable; value could not be calculated.

Table 6-49. Site-Wide Surface Soil Exposure Point Concentrations of Chemicals of Potential Concern (SWMU 40)

Chemical	Frequency of Detection[a]	Range of Detected Values (μg/g)	Range of Reporting Limits (μg/g)	Arithmetic Mean Concentration (μg/g)	95% UCL Concentration (μg/g)	Exposure Point Concentration[b] (μg/g)
Arsenic	60/71	2.54 - 17.9	24.0 - 240	9.09	11.0	11.0
Barium	71/71	43.0 - 2,800	NA	118	133	133
Lead	64/71	8.11 - 1,600	7.44	31.9	45.1	45.1
1,3,5-Trinitrobenzene	1/76	3.27	0.35 - 0.92	0.45	0.49	0.49
HMX	9/80	1.49 - 485	0.76 - 20.0	1.72	2.2	2.2
RDX	10/80	1.45 - 3,200	0.45 - 1.28	2.2	3.4	3.4

[a]Number of samples in which the analyte was detected/total number of samples analyzed.
[b]The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable.

Table 6-50. Selection of COPCs for Groundwater Exposure Pathways (SMWU 40)

Chemical	Maximum Above Background ($\mu g/g$)[a]	Depth	Soil-to-GW RBC[b] ($\mu g/g$)	Selected for Vadose Zone Modeling?	Reached the Water Table Within 100 Years	Model Output: Break-Through Point Concentration in Groundwater (mg/L)[c]	Tap Water RBC (mg/L)	Selected as COPC[d] for Groundwater?
Arsenic	29.3	Subsurface	15	YES	No	NA[e]	---	No
Barium	2,800	Surface	3.2	YES	No	NA	---	No
Cadmium	6.31	Surface	0.6	YES	No	NA	---	No
Chromium	44.3	Surface	1.9	YES	No	NA	---	No
Cobalt	8.78	Surface	119[f]	No	No	NA	---	No
Copper	224	Surface	31[f]	YES	No	NA	---	No
Lead	1,600	Surface	15	YES	No	NA	---	No
Mercury	0.395	Subsurface	0.3[f]	YES	No	NA	---	No
Nickel	25	Surface	2.1	YES	No	NA	---	No
Silver	0.93	Surface	19[f]	No	No	NA	---	No
Vanadium	49.6	Surface	5.2[f]	YES	No	NA	---	No
Zinc	665	Surface	4,200	No	No	NA	---	No
Nitrate	115	Subsurface	2	YES	No	NA	---	No
1,3,5-Trinitrobenzene	3.27	Surface	0.00073[f]	YES	No	NA	---	No
2,4-Dinitrotoluene	8.15	Surface	0.02	YES	YES	0.3752	.0073	YES
2,4,6-Trinitrotoluene	14.4	Surface	0.053[f]	YES	No	NA	---	No
Diethyl phthalate	6.8	Surface	11.0	No	No	NA	---	No
Dimethyl phthalate	8.5	Surface	120	No	No	NA	---	No
Di-n-butyl phthalate	0.167	Surface	12.0	No	No	NA	---	No
HMX	485	Surface	0.06[f]	YES	YES	33.7	.03	YES
Nitroguanidine	0.35	Surface	0.74[f]	No	No	NA	---	No
RDX	3,200	Surface	0.002[f]	YES	YES	222.1	0.0006	YES
Tetryl	18	Subsurface	0.37[f]	YES	YES	2.15	0.037	YES

Note.—RBCs were taken directly from the Region III RBC Table except as indicated in the footnotes.
[a]Micrograms per gram.
[b]Risk-based calculations.
[c]Milligrams per liter; value taken from Table 6-49.
[d]Chemicals of potential concern.
[e]Not applicable.
[f]Eliminated as a groundwater COPC if the chemical reached the water table in more than 100 years or did not exceed the tap water RBC.
--- = Not applicable; not modeled, or vadose zone modeling showed that the chemical break-through time to the water table is greater than 100 years.

water RBC (one-tenth of the value for noncarcinogens) was retained for further vadose-saturated zone modeling to on- and off-site hypothetical receptors as described in Section 2.7.2. For this second phase of modeling, the *average* surface and subsurface soil concentration was used to calculate the initial pore water concentration at the site. Again, the vadose-saturated zone modeling results were compared to the Region III tap water RBCs, with one-tenth for noncarcinogens. If the chemical still failed to meet the 100-year break-through criteria *and* exceeded the Region III tap water RBC, it was retained for quantitative risk assessment. As shown in Table 6-50, arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, vanadium, nitrate, 1,3,5-trinitrobenzene, 2,4-dinitrotoluene, 2,4,6-trinitrotoluene, HMX, RDX, and tetryl were retained for vadose zone modeling at SWMU 40. Of these chemicals, only four chemicals had a break-through time of less than 100 years: 2,4-dinitrotoluene, HMX, RDX, and tetryl (Table 6-51).

6.2.4.2.1 ***Vadose Zone Model Results.*** The soil screening described in the previous sections indicated that 16 COPCs should be evaluated using the soil-vadose-zone-groundwater screening model at SWMU 40. These COPCs consist of nine metals, six explosive compounds, and nitrate as indicated in Table 6-51. The vadose modeling set-up procedures are described in detail in Section 2.7.2 of this report. This section defines the site specific parameters and presents the vadose zone modeling results.

The SWMU 40 site specific input parameters are defined as the vadose zone thickness (H cm), the area of contamination (CA m^2), and the thickness of the contaminated zone (H cont, cm). These input parameters, along with the COPC chemical-specific parameters are used as the input for the GWM-1 and MULTIMED models. The above site-specific parameters for SWMU 6 are as follows:

H = 10,700 cm

CA = 140,460 m^2

H cont = 213 cm

Other key COPC specific parameters—the distribution coefficient (Kd), the maximum observed soil concentration (Tc), the initial pore water concentration (C_{init}), and the plume pulse duration (p.d.)—are also shown in Table 6-51. All of the GWM-1 spreadsheets associated with the 16 SWMU-specific COPCs are in Appendix K. Table 6-51 summarizes these COPC-specific parameters and shows the MULTIMED output for COPC break-through time (time after leaching starts, that the leading edge of the COPC plume reaches the top of the water table) along with the COPC estimated concentration at the time that breakthrough occurs. One key to interpret these estimates is determining the pore water concentration by starting with the maximum observed soil concentration measured at the site (see Table 6-51) and calculating the maximum concentration available for the pore water solution by soil-water partitioning. As explained in Section 2.7.2, the equation used is very dependent on Kd and does not take into account mineral solubility and equilibrium relationships. This is evident by some of the high C_{init} concentrations estimated for the several of the COPCs.

Table 6-51. Summary of Break-Through Vadose Zone Modeling Results and Critical I/O GWM-1 and MULTIMED Parameters for SWMU 40

Analyte	Kd[a]	Tc[b] (max) (ppm)	C_{leak}[c] (mg/L)	Breakthrough Time (yrs)	Breakthrough Conc. (mg/L)	p.d.[d] (yrs)
		COPC Specific Parameters				
Arsenic	1	29.3	29.3	803	0.0018	41
Barium	52	2,800	59.7	40,000	1.123	1,911
Cadmium	1.3	6.31	4.97	1,053	0.0673	52
Chromium	1.2	44.3	37.5	953	0.0531	48
Copper	1.4	224	165	1,100	0.3671	55
Lead	4.5	1,600	38.6	3,400	0.0722	169
Mercury	10	0.395	0.0435	7,500	0.00014	371
Nickel	150	25	0.0695	>95,000	ND[e]	14,674
Vanadium	1,000	49.6	0.0551	>95,000	ND	36,678
Nitrate	1	115	115	803	0.007	41
1,3,5-Trinitrobenzene	1	3.27	3.27	113	0.008	41
2,4,6-Trinitrotoluene	1	14.4	14.4	510	0.2158	41
2,4-Dinitrotoluene	1	8.15	8.15	98	0.3752	41
RDX	1	3,200	3,200	73	222.1	41
HMX	1	485	485	73	33.7	41
Tetryl	1	18	18	73	1.25	41

Note.—Site-specific parameters for SWMU are as follows: vadose zone thickness (H) = 10,700 cm; area of contaminated soil (CA) = 140,460 m^2; and thickness of contaminated soil (Hcont) - 213 cm.

[a]The distribution coefficient and is dimensionless.

[b]The maximum observed soil concentration (ppm).

[c]The pore water concentration at the source as conservatively calculated by GWM-1.

[d]The pulse duration as calculated by GWM-1.

[e]Not determined.

6.2.4.2.2 *Groundwater COPCs.* As shown in Table 6-51, the MULTIMED output indicates that within a 100-year time period 2,4-dinitrotoluene, RDX, HMX, and tetryl will travel downward through the vadose zone and reach the water table. No other COPC reaches the water table within this period. As discussed in detail in Section 2.7.2, the conservative approach was the basis for the model calculations. All four of the COPCs estimated to reach the water table within the 100-year period exceed the Tap Water RBC indicated in Table 6-51. However, none of the contaminants cross the vadose zone in less than the 50-year period at the TEAD-N site. The COPC sources are believed to have been present no longer than 50 years. This suggests that this potential soil-to-groundwater pathway has not been completed.

Table 6-51 illustrates this concept, showing the critical input and output parameters and the estimated break-through time for each COPC. This table also shows the estimated concentration associated with the arrival of the leading edge of the COPC plume at the water table. Again, it should be noted that the break-through time calculation does not take into account the various retardation influences, such as biodegradation, volatilization, absorption, adsorption, and mineral-solution equilibrium relationships.

The explosive compounds 2,4-dinitrotoluene, RDX, HMX, and tetryl reach the water table in approximately 98, 73, 73, and 73 years, respectively. Additionally, MULTIMED calculations show that nickel and vanadium should not contact the water table until sometime after 95,000 years (MULTIMED is limited to 99,999 years for the transient simulation). The remainder of the COPCs ranged in break-through time from approximately 113 years for 1,3,5-trinitrobenzene to over 95,000 years for nickel and vanadium. Table 6-51 summarizes all 16 of the COPCs identified at SWMU 40.

To further evaluate the potential for 2,4-dinitrotoluene, RDX, HMX, and tetryl to affect human health, the saturated zone model was expanded to estimate the maximum on-site COPC concentration and the maximum off-site concentration at a hypothetical receptor on the northern boundary of TEAD-N. Various input parameters were adjusted to accommodate the saturated zone modeling to the on-site and off-site receptors. These parameters included the aquifer thickness (50 meters), the mixing zone thickness (50 meters), and the initial pore water (set equal to the average observed soil concentration). In addition, the hydraulic gradient (0.0077—dimensionless) and distance (6,200 meters) to the off-site receptor were adjusted to represent simulation to the hypothetical receptors at SWMU 40 (see Section 2.7.2). The remaining input parameters were not adjusted. The hydraulic gradient, distance to the off-site receptor, and the modeling results are shown in Table 6-52. The on-site receptor was set to 1 meter from the point that the COPC first reached the water table, thus representing the saturated zone directly underlying the SWMU. Based on the results in Table 6-52, all four chemicals were carried through as groundwater COPCs for future on-site adult residents.

6.2.4.3 *Exposure Assessment*

Exposure is defined as the contact of a receptor with a chemical (USEPA 1989c). Exposure assessment is the estimation of the magnitude, frequency, and duration for each identified

Table 6-52. Summary of Vadose Zone and Saturated Zone Modeling to Hypothetical On-Site and Off-Site Receptors for SWMU 40 (Using Average Soil Concentrations)

SWMU	Chemical	Tc[a] (avg) ppm	Cinit[b] (mg/L)	Est. Peak On Site Receptor Conc. (mg/L)	Est. Peak On Site Time (yrs)	Est. Peak Off Site Receptor Conc. (mg/L)	Est. Peak Off Site Time (yrs.)	Est. Hydraulic Gradient (dimensionless)	Est. Contaminated Area (m^2)	Est. Distance to Receptor (m)
40	RDX	17	17	4.136	113	0.00317	423	0.0077	140460	6200
40	HMX	3.47	3.47	0.844	113	0.00064	453	0.0077	140460	6200
40	2,4-DNT	1.2	1.2	0.2495	143	0.00023	453	0.0077	140460	6200
40	Tetryl	1.13	1.13	0.289	113	0.000071	653	0.0077	140460	6200

[a]The average observed soil concentation (ppm).
[b]The pore water concentration at the source as conservatively calculated by GWM-1.

route of exposure. The magnitude of an exposure is determined by estimating the amount of chemical available at the receptor exchange boundaries (i.e., lungs, gastrointestinal tract, or skin) during a specified time period. Section 3.1.2 describes the general tasks comprising the exposure assessment. The specific application of these tasks to SWMU 40 is described below.

6.2.4.3.1 *Characterization of Exposure Setting*. The first step in developing exposure scenarios for SWMU 40 was to characterize the site setting in which potential exposures might occur. The characteristics of the site setting influence the types of transport mechanisms and the type of receptor exposure that could occur. The site setting also provides a basis for identifying the potential receptors (either real or, in the case of site redevelopment for alternative use, hypothetical). Both current land use patterns and future land use patterns were examined as part of the characterization.

Current Land Use. As is true for other areas of TEAD-N, public access to SWMU 40 is controlled, thereby precluding transient exposure. SWMU 40 is located in the northwest portion of TEAD-N and will remain part of the depot mission for the foreseeable future. Data were not available on the frequency of use of the AED Test Range.

Based on the above information, potential receptors under current land use were defined as:

- SWMU-specific laborers and security personnel—Individuals with job descriptions that call for repeated, moderate to heavy labor in the general vicinity of SWMU 40 and staff assigned to maintenance of the perimeter or security personnel that repeatedly work in the vicinity of SWMU 40

- Military personnel during testing

- Off-site residents—Military personnel and/or civilians living near the depot perimeter

It was assumed that the SWMU-specific laborer scenario would provide a sufficient upper bound for on-site risk to encompass occasional use by military personnel for weapons testing. Because these other potential receptors would be exposed only intermittently to SWMU 40, SWMU-specific laborers and security personnel were the only on-site receptors evaluated quantitatively as a current-use scenario. This approach provides a series of upper-bound estimates. Off-site residents living near the depot boundary may potentially be exposed to SWMU-related chemicals bound to resuspended particulate. Therefore, the inhalation pathway is quantitatively evaluated for these receptors.

Cattle grazing is permitted at TEAD-N, with grazing allotments competitively bid and leased every 5 years to a single rancher. The current lease is up for rebid in 1996. Grazing at TEAD-N typically occurs between October 15 and May 31, with calving taking place in January. The calves remain at the facility until May 31 when they are either moved to feedlots or to other grazing areas. The calves typically do not return to TEAD-N after their initial exposure, and they are eventually sold as slaughter cattle for human consumption.

Distribution is through regional and national distribution networks. The cows are normally utilized as breeding stock and may or may not return to the site during consecutive years. The current lessee brings approximately 1,000 head, mostly heifers, to winter pasture at TEAD-N and maintains summer pasture in Idaho (M. Walker, personal communication with Rust E&I, 1994). SWMU 40 is part of one grazing allotment currently under lease. Therefore, consumption of beef grazed on the allotment, of which SWMU 40 is a part, is evaluated in the risk assessment.

Future Land Use. No change in current use is planned for the AED Test Range; therefore, some exposure scenarios that are analogous to current-use scenarios described above will continue (e.g., SWMU-specific laborers and security personnel). Current BRAC recommendations retain SWMU 40's function as part of the depot's mission. However, should the mission of TEAD-N change in the future, two additional exposure scenarios unique to planned or potential future use of SWMU 40 were developed.

- Skilled laborers—Individuals assigned to short-term construction in the vicinity of SWMU 6 during potential redevelopment.

- Inhabitants of an on-site residence(s)—Individuals who live in residences established at the time that depot property should ever be transferred for redevelopment.

6.2.4.3.2 ***Characterization of Potential Exposure Pathways***. An exposure pathway is the route COPCs take to reach potential receptors. Section 3.1.2.1 and 3.1.2.2 describe the methodology for characterization of exposure pathways. This methodology was then applied to SWMU 40. The following sections describe the potential exposure pathways associated with SWMU 40 for the current and future land use scenarios.

Current Land Use. Currently, the majority of laborers at TEAD-N work 10-hour days with 4-day weeks. Assuming a total of 4 weeks off a year for vacation, holidays, and sick leave, this yields 192 days per year on the job. It is assumed that a laborer could be at any specific SWMU from 2 (CTE) to 10 (RME) hours per day and will incidentally ingest, inhale, or come in contact with surface soil through work-related activities. Military personnel are rotated on assignment an average of every 3 years (S. Culley, personal communication with Rust E&I, 1994). If a laborer is a civilian, the length of assignment could be expected to range as high as 25 years. It is assumed that all of the exposure is from outdoor tasks or activities. Specific parameters relating to ingestion, contact, and ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

For the current off-site adult resident, it was assumed that at least one parent would spend much of his or her time away from home in activities such as working at another location, household errands, personal care (e.g., medical/dental appointments), or leisure activities. Based on this assumption, the total estimated time an adult spends at home is approximately 15 to 19 hours per day, conducting activities such as gardening, mowing, or outdoor sports. For children, ages 0 to 18, time activity patterns indicate that they spend an average of approximately 30 hours per week away from home to attend school or daycare at a location

other than their home. The total time a child spends at home averaged over a 7-day week is 20 hours per day. It is assumed that residents spend 2 (RME) to 4 (CTE) weeks away from home on vacation or long holiday weekends. Therefore, the exposure frequency in real time is 335 days per year (CTE) to 350 days per year (RME). Because the contact rate for ingestion and dermal exposure is in daily units, the exposure frequency for these pathways is prorated into 24-hour day equivalents. This ranges from 216 days per year (CTE adult) to 276 days per year (CTE child) and 273 days per year (RME adult) to 288 days per year (RME child) (see Appendix L). Years spent at one residence for the adult/child range from 8 (CTE) to 30 (RME) years based on studies compiled by the USEPA (1989c) and AIHC (1994). Specific parameters relating to ventilation rates, body weights, and bioavailability are given in Appendix L.

As discussed previously, portions of SWMU 40 are allotted for grazing by cattle. The current beef consumer is assumed to eat approximately 1 to 3 ounces of beef a day, of which 44 to 88 percent originates from the grazing allotment at SWMU 40. Specific parameters relating to this pathway are given in Appendix L.

Future Land Use. Based on the future usage of SWMU 40, it is possible that industrial construction may be conducted to increase the capacity of the military operations at TEAD-N. For these reasons, the future construction worker scenario was evaluated. It is assumed that a construction company could be contracted for a work period ranging from 1 to 3 years, and a single worker could be at the site conducting activities outdoors from 2 to 4 months of the year. It is assumed that the worker works as much as 8 to 10 hours per day and may incidentally ingest, inhale, or come in contact with subsurface soil through construction-related activities. Specific parameters relating to ingestion, contact, ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

Should the future planned use of SWMU 40 change and the property be zoned for potential residential development, the future on-site adult and child residents are also evaluated for the future land use scenario. For the future on-site adult resident, it was assumed that at least one parent would spend much of his or her time away from home in activities such as working at another location, household errands, personal care (e.g., medical/dental appointments), or leisure activities. Based on this assumption, the total estimated time an adult will spend at home is approximately 15 to 19 hours per day, during which time he or she may incidentally ingest, inhale, or come in contact with surface soil while conducting activities such as gardening, mowing, or outdoor sports. It is also expected that the future on-site resident will grow and harvest vegetables and fruits from a home garden. For children and adolescents ages 0 to 18, time activity patterns indicate that they spend an average of approximately 30 hours per week away from home to attend school or day care. The total time a child spends at home, averaged over a 7-day week, is approximately 20 hours per day. It is assumed that residents spend 2 (RME) to 4 (CTE) weeks away from home on vacation or long holiday weekends. Therefore, the exposure frequency in real time is 335 days per year (CTE) to 350 days per year (RME). Because the contact rate for ingestion and dermal exposure is in daily units, the exposure frequency for these pathways is prorated into 24-hour-day equivalents. This ranges from 216 days per year (CTE adult) to 276 days per year (CTE child) and from 273 days per year (RME adult) to 288 days per year (RME child) (see Appendix L). Years

spent at one residence for the adult/child range from 8 (CTE) to 30 (RME) years based on studies compiled by the USEPA (1989c) and AIHC (1994). Specific parameters relating to ingestion, contact, ventilation rates, body weights, and absorption or bioavailability are given in Appendix L.

In addition to the pathways discussed above, for the potential on-site adult resident at SWMU 40, the ingestion of groundwater pathway was separately evaluated. It is assumed that adults drink between 1.4 to 2 liters per day of well water associated with SWMU 40. Other parameters such as exposure frequency, duration, and body weight are the same as discussed above.

6.2.4.3.3 ***Exposure Point Concentrations***. The EPC is defined as the concentration of a COPC in an exposure medium that will be contacted over a real or hypothetical exposure duration. EPCs at SWMU 40 were evaluated for current and future land use. Estimation of EPCs is fully described in Appendix L. For brevity, only information specific to SWMU 40 is presented in the following sections.

As discussed in Sections 6.2.4.1 and 6.2.4.2, two areas of concern were evaluated for SWMU 40. Based on the screening methodology, EPCs were estimated for surface and/or subsurface soils for all areas of concern—Hot Spot Near Old Furnace Building, Hot Spot in Vicinity of Test Pit ARP-94-48—as well as the remainder of the SWMU, not including the areas of conern and the SWMU as a whole.

Current Land Use. EPCs for surface soil ingestion and dermal contact by personnel at SWMU 40 were estimated for the CTE and RME exposure scenario using Phase I and II RI data. Because the duties of on-site personnel vary, EPCs were developed for each area of concern and balance of area associated with the SWMU, as well as the SWMU as a whole in order to encompass all potential exposure scenarios for this receptor.

EPCs in beef were estimated based on the EPCs in surface soil as discussed above. Details of the estimation of beef tissue uptake from forage are presented in Appendix L. Air EPCs for on-site personnel and off-site residents were estimated using USEPA's SCREEN2 model. Air emissions were not evaluated for each specific area of concern. It was assumed that the SWMU, as a whole, was the main source for air emission generation for all on- and off-site receptors. Details of the estimation of emission rates from surface soils and dispersion modeling are described in Appendix N. Tables 6-53 through 6-60 present the EPCs for on-site personnel and off-site residents associated with SWMU 40.

Future Land Use. EPCs for subsurface soil ingestion and dermal contact by hypothetical construction workers at SWMU 40 were estimated using the same methods as those used for the on-site personnel under the current land use scenario (see Appendix L). However, it was assumed that the construction projects would be limited in size; therefore, potential exposure pathways are not evaluated for the SWMU as a whole but are limited to the specific areas of concern. EPCs for inhalation of particulates were modeled, as described in Appendix N, for the hypothetical future on-site construction worker and resident (Tables 6-53 through 6-60).

6.2.4.3.4 *Estimation of Chemical Intakes.* The exposure models described in detail in Appendix L together with EPCs listed in Tables 6-53 through 6-60 were used to estimate intake for the potential exposure scenarios. Note that averaging time differs for carcinogens and noncarcinogens. Because exposure to soil is likely to be higher for young children and adolescents ages 0 to 18 years, intakes were calculated separately from the adults. Estimates of exposure intakes are given in Tables 6-61 through 6-92.

6.2.4.4 *Toxicity Assessment*

Information of the toxicological effects of carcinogenic and systemic toxicants are summarized in Appendix M. This toxicity assessment includes brief toxicity profiles on data listed in USEPA's IRIS database and published in HEAST (USEPA 1994). These profiles describe the acute, chronic, and carcinogenic health effects associated with SWMU-related chemicals. Toxicity values for COPCs associated with SWMU 40 are summarized in Tables 6-61 through 6-92.

6.2.4.5 *Risk Characterization*

This section provides a characterization of the potential health risks using the intake of chemicals associated with SWMU 40 (Hot Spot Near Old Furnace Building and Hot Spot in Vicinity of Test Pit ARP-94-48). In addition, potential risks were evaluated for the remainder of SWMU 40, not including the areas of concern and SMWU 40 as a whole. The risk characterization compares estimated potential ILCRs with reasonable levels of risk for potential carcinogens (see Section 3.1.4.1), and the estimated daily intake of systemic toxicants with appropriate reference levels. Some carcinogenic chemicals may also pose a systemic hazard, and these potential hazards are characterized as for other systemic toxicants. Each of the areas associated with SWMU 40 are discussed separately below.

6.2.4.5.1 *Characterization of Potential Carcinogenic Risks.* The USEPA currently classifies lead salts as probable human carcinogens (Class B2). However, quantifying lead's cancer risk involves many uncertainties, some of which may be unique to lead. Age, health, nutritional state, body burden, and exposure duration influence the absorption, release, and excretion of lead. In addition, current knowledge of lead pharmacokinetics indicates that an estimate derived by standard procedures would not truly describe the potential risk. Thus, the USEPA's Carcinogen Assessment Group recommends that a numerical estimate not be used (USEPA 1995a).

Hot Spot Near Old Furnace Building. The general process used to select the COPCs associated with the Hot Spot Near Old Furnace Building area of concern is described in Section 3.1.1.2. COPC selection for SWMU 40 is described in Section 6.2.4.2. For current and future land use scenarios, arsenic, barium, lead, 1,3,5-trinitrobenzene, HMX, and RDX were identified as COPCs. Arsenic, a known human carcinogen, is the only COPC that contributes to the carcinogenic risk. Tables 6-53 and 6-54 list the COPCs and their associated media.

Table 6-53. Adult Exposure Point Concentrations for Hot Spot Near Old Furnace Building Area of Concern Associated with SWMU 40

	Exposure Point Concentration	
Chemical	**CTE**	**RME**
Current Land Use		
Surface Soil (mg/kg)		
Arsenic	12.7	12.7
Lead	403	403
Air (μg/m³)		
Arsenic	0.00058	0.00058
Barium	0.0070	0.0070
Lead	0.0017	0.0017
1,3,5-Trinitrobenzene	0.000026	0.000026
HMX	0.00012	0.00012
RDX	0.00018	0.00018
Future Land Use [a]		
Surface Soil (mg/kg)[b]		
Air (μg/m³)[b]		
Tubers/Fruits (mg/kg)		
Arsenic	0.017	0.017
Lead	0.80	0.80
Leafy Vegetables (mg/kg)		
Arsenic	0.11	0.11
Lead	1.27	1.27

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.
[b]Future use concentrations are the same as for the current use scenarios.

Table 6-54. Child Exposure Point Concentrations for Hot Spot Near Old Furnace Building Area of Concern Associated with SWMU 40

	Exposure Point Concentration	
Chemical	**CTE**	**RME**
Future Land Use [(a)]		
Surface Soil (mg/kg)		
Arsenic	12.7	12.7
Lead	403	403
Air ($\mu g/m^3$)		
Arsenic	0.00058	0.00058
Barium	0.0070	0.0070
Lead	0.0017	0.0017
1,3,5-Trinitrobenzene	0.000026	0.000026
HMX	0.00012	0.00012
RDX	0.00018	0.00018
Tubers/Fruits (mg/kg)		
Arsenic	0.017	0.017
Lead	0.80	0.80
Leafy Vegetables (mg/kg)		
Arsenic	0.11	0.11
Lead	1.27	1.27

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Table 6-55. Adult Exposure Point Concentrations for Hot Spot in Vicinity of Test Pit ARP-94-48 Area of Concern Associated with SWMU 40

	Exposure Point Concentration	
Chemical	**CTE**	**RME**
Current Land Use		
Surface Soil (mg/kg)		
Barium	2,800	2,800
HMX	485	485
RDX	3,200	3,200
Air (μg/m³)		
Arsenic	0.00058	0.00058
Barium	0.0070	0.0070
Lead	0.0017	0.0017
1,3,5-Trinitrobenzene	0.000026	0.000026
HMX	0.00012	0.00012
RDX	0.00018	0.00018
Future Land Use [a]		
Surface Soil (mg/kg)[b]		
Air (μg/m³)[b]		
Tubers/Fruits (mg/kg)		
Barium	9.24	9.24
HMX	28,900	28,900
RDX	270,000	270,000
Leafy Vegetables (mg/kg)		
Barium	92.4	92.4
HMX	826	826
RDX	7,710	7,710

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.
[b]Future use concentrations are the same as for the current use scenarios.

Table 6-56. Child Exposure Point Concentrations for Hot Spot in Vicinity of Test Pit ARP-94-48 Area of Concern Associated with SWMU 40

	Exposure Point Concentration	
Chemical	**CTE**	**RME**
Future Land Use [(a)]		
Surface Soil (mg/kg)		
Barium	2,800	2,800
HMX	485	485
RDX	3,200	3,200
Air ($\mu g/m^3$)		
Arsenic	0.00058	0.00058
Barium	0.0070	0.0070
Lead	0.0017	0.0017
1,3,5-Trinitrobenzene	0.000026	0.000026
HMX	0.00012	0.00012
RDX	0.00018	0.00018
Tubers/Fruits (mg/kg)		
Barium	9.24	9.24
HMX	28,900	28,900
RDX	270,000	270,000
Leafy Vegetables (mg/kg)		
Barium	92.4	92.4
HMX	826	826
RDX	7,710	7,710

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Table 6-57. Adult Exposure Point Concentrations for Remainder of SWMU 40 Outside Areas of Concern

	Exposure Point Concentration	
Chemical	**CTE**	**RME**
Current Land Use		
Surface Soil (mg/kg)		
Arsenic	11.4	11.4
1,3,5-Trinitrobenzene	0.513	0.513
Air ($\mu g/m^3$)		
Arsenic	0.00058	0.00058
Barium	0.0070	0.0070
Lead	0.0017	0.0017
1,3,5-Trinitrobenzene	0.000026	0.000026
HMX	0.00012	0.00012
RDX	0.00018	0.00018
Future Land Use [a]		
Surface Soil (mg/kg)[b]		
Air Emissions from Surface Soil ($\mu g/m^3$)[b]		
Subsurface Soil (mg/kg)		
Arsenic	7.57	7.57
Air Emissions from Subsurface Soil ($\mu g/m^3$)		
Arsenic	0.031	0.031
Tubers/Fruits (mg/kg)		
Arsenic	0.015	0.015
1,3,5-Trinitrobenzene	6.85	6.85
Leafy Vegetables (mg/kg)		
Arsenic	0.10	0.10
1,3,5-Trinitrobenzene	0.20	0.20

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.
[b]Future use concentrations are the same as for the current use scenarios.

Table 6-58. Child Exposure Point Concentrations for Remainder of SWMU 40 Outside Areas of Concern

Chemical	Exposure Point Concentration CTE	RME
Future Land Use [a]		
Surface Soil (mg/kg)		
Arsenic	11.4	11.4
1,3,5-Trinitrobenzene	0.513	0.513
Air ($\mu g/m^3$)		
Arsenic	0.00058	0.00058
Barium	0.0070	0.0070
Lead	0.0017	0.0017
1,3,5-Trinitrobenzene	0.000026	0.000026
HMX	0.00012	0.00012
RDX	0.00018	0.00018
Tubers/Fruits (mg/kg)		
Arsenic	0.015	0.015
1,3,5-Trinitrobenzene	6.85	6.85
Leafy Vegetables (mg/kg)		
Arsenic	0.10	0.10
1,3,5-Trinitrobenzene	0.20	0.20

[a]For a description of the methodology used for development of future exposure point concentrations, see Appendix L.

Table 6-59. Adult Exposure Point Concentrations for SWMU 40 as a Whole

	Exposure Point Concentration	
Chemical	**CTE**	**RME**
Current Land Use		
Surface Soil (mg/kg)		
Arsenic	11.0	11.0
Barium	133	133
Lead	31.9	31.9
1,3,5-Trinitrobenzene	0.49	0.49
HMX	2.2	2.2
RDX	3.4	3.4
On-site Air ($\mu g/m^3$)		
Arsenic	0.00058	0.00058
Barium	0.0070	0.0070
Lead	0.0017	0.0017
1,3,5-Trinitrobenzene	0.000026	0.000026
HMX	0.00012	0.00012
RDX	0.00018	0.00018
Off-site Air ($\mu g/m^3$)		
Arsenic	0.00032	0.00032
Barium	0.0039	0.0039
Lead	0.00092	0.00092
1,3,5-Trinitrobenzene	0.000014	0.000014
HMX	0.000064	0.000064
RDX	0.000098	0.000098
Groundwater (mg/L)		
HMX	0.84	0.84
RDX	4.1	4.1
2,4-Dinitrotoluene	0.25	0.25
Tetryl	0.29	0.29

Table 6-60. Adult and Child Exposure Point Concentrations for Beef Tissue from Cattle Associated with Grazing Allotment 3 (SWMU 40)

Chemical	Exposure Point Concentration	
	CTE	**RME**
Current Land Use		
Beef Tissue - Adult (mg/kg)		
Arsenic	0.00014	0.00014
Barium	0.00025	0.00025
Lead	0.000022	0.000022
1,3,5-Trinitrobenzene	0.00000032	0.00000032
HMX	0.00000047	0.00000047
RDX	0.00000056	0.00000056
Beef Tissue - Child (mg/kg)		
Arsenic	0.00014	0.00014
Barium	0.00025	0.00025
Lead	0.000022	0.000022
1,3,5-Trinitrobenzene	0.00000032	0.00000032
HMX	0.00000047	0.00000047
RDX	0.00000056	0.00000056

Table 6-61. Summary of Potential Carcinogenic Risk Results for the Current/Future On-Site Laborer for SWMU 40 (Hot Spot Near Old Furnace Building)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.3E+01	1.2E-09	1.5E+00	1.8E-09	
Lead	4.0E+02	NA[d]	NA	NA	
			Pathway Total:	1.8E-09	79%
Dermal Contact with Surface Soil					
Arsenic	1.3E+01	6.0E-11	1.5E+00	9.2E-11	
Lead	4.0E+02	NA	NA	NA	
			Pathway Total:	9.2E-11	4%
Inhalation of Particulates					
Arsenic	5.8E-07	2.7E-11	1.5E+01	4.0E-10	
Barium	7.0E-06	NA	NA	NA	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	4.0E-10	17%
			Total CTE ILCR:	2.3E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.3E+01	9.7E-07	1.5E+00	1.4E-06	
Lead	4.0E+02	NA	NA	NA	
			Pathway Total:	1.4E-06	84%
Dermal Contact with Surface Soil					
Arsenic	1.3E+01	1.1E-07	1.5E+00	1.7E-07	
Lead	4.0E+02	NA	NA	NA	
			Pathway Total:	1.7E-07	10%
Inhalation of Particulates					
Arsenic	5.8E-07	6.4E-09	1.5E+01	9.6E-08	
Barium	7.0E-06	NA	NA	NA	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	9.6E-08	6%
			Total RME ILCR:	1.7E-06	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-62. Summary of Potential Carcinogenic Risk Results for the Future On-Site Adult Resident for SWMU 40 (Hot Spot Near Old Furnace Building)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) (mg/kg-day)-1	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.3E+01	1.1E-07	1.5E+00	1.7E-07	
Lead	4.0E+02	NA(d)	NA	NA	
			Pathway Total:	1.7E-07	4%
Dermal Contact with Surface Soil					
Arsenic	1.3E+01	5.6E-09	1.5E+00	8.5E-09	
Lead	4.0E+02	NA	NA	NA	
			Pathway Total:	8.5E-09	0%
Inhalation of Particulates					
Arsenic	5.8E-07	2.1E-09	1.5E+01	3.2E-08	
Barium	7.0E-06	NA	NA	NA	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	3.2E-08	1%
Ingestion of Leafy Vegetables					
Arsenic	1.1E-01	1.6E-06	1.5E+00	2.4E-06	
Lead	1.3E+00	NA	NA	NA	
			Pathway Total:	2.4E-06	62%
Ingestion of Tubers and Fruits					
Arsenic	1.7E-02	8.4E-07	1.5E+00	1.3E-06	
Lead	8.0E-01	NA	NA	NA	
			Pathway Total:	1.3E-06	33%
			Total CTE ILCR:	3.8E-06	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.3E+01	2.6E-06	1.5E+00	4.0E-06	
Lead	4.0E+02	NA	NA	NA	
			Pathway Total:	4.0E-06	7%
Dermal Contact with Surface Soil					
Arsenic	1.3E+01	3.1E-07	1.5E+00	4.7E-07	
Lead	4.0E+02	NA	NA	NA	
			Pathway Total:	4.7E-07	1%
Inhalation of Particulates					
Arsenic	5.8E-07	1.1E-08	1.5E+01	1.7E-07	
Barium	7.0E-06	NA	NA	NA	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	1.7E-07	0%
Ingestion of Leafy Vegetables					
Arsenic	1.1E-01	2.2E-05	1.5E+00	3.3E-05	
Lead	1.3E+00	NA	NA	NA	
			Pathway Total:	3.3E-05	61%
Ingestion of Tubers and Fruits					
Arsenic	1.7E-02	1.1E-05	1.5E+00	1.7E-05	
Lead	8.0E-01	NA	NA	NA	
			Pathway Total:	1.7E-05	31%
			Total RME ILCR:	5.4E-05	100%

[a]Units for the inhalation pathway are mg/m³.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-63. Summary of Potential Carcinogenic Risk Results for the Future On-Site Child Resident for SWMU 40 (Hot Spot Near Old Furnace Building)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.3E+01	5.0E-07	1.5E+00	7.6E-07	
Lead	4.0E+02	NA(d)	NA	NA	
			Pathway Total:	7.6E-07	11%
Dermal Contact with Surface Soil					
Arsenic	1.3E+01	9.4E-09	1.5E+00	1.4E-08	
Lead	4.0E+02	NA	NA	NA	
			Pathway Total:	1.4E-08	0%
Inhalation of Particulates					
Arsenic	5.8E-07	1.1E-08	1.5E+01	1.6E-07	
Barium	7.0E-06	NA	NA	NA	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	1.6E-07	2%
Ingestion of Leafy Vegetables					
Arsenic	1.1E-01	2.7E-06	1.5E+00	4.1E-06	
Lead	1.3E+00	NA	NA	NA	
			Pathway Total:	4.1E-06	58%
Ingestion of Tubers and Fruits					
Arsenic	1.7E-02	1.4E-06	1.5E+00	2.1E-06	
Lead	8.0E-01	NA	NA	NA	
			Pathway Total:	2.1E-06	29%
			Total CTE ILCR:	7.1E-06	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.3E+01	5.6E-06	1.5E+00	8.4E-06	
Lead	4.0E+02	NA	NA	NA	
			Pathway Total:	8.4E-06	20%
Dermal Contact with Surface Soil					
Arsenic	1.3E+01	1.3E-07	1.5E+00	2.0E-07	
Lead	4.0E+02	NA	NA	NA	
			Pathway Total:	2.0E-07	0%
Inhalation of Particulates					
Arsenic	5.8E-07	1.8E-08	1.5E+01	2.6E-07	
Barium	7.0E-06	NA	NA	NA	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	2.6E-07	1%
Ingestion of Leafy Vegetables					
Arsenic	1.1E-01	1.4E-05	1.5E+00	2.2E-05	
Lead	1.3E+00	NA	NA	NA	
			Pathway Total:	2.2E-05	52%
Ingestion of Tubers and Fruits					
Arsenic	1.7E-02	7.3E-06	1.5E+00	1.1E-05	
Lead	8.0E-01	NA	NA	NA	
			Pathway Total:	1.1E-05	26%
			Total RME ILCR:	4.1E-05	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-64. Summary of Potential Carcinogenic Risk Results for the Current/Future On-Site Laborer for SWMU 40 (Hot Spot in Vicinity of Test Pit ARP-94-48)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Barium	2.8E+03	NA[d]	NA	NA	
HMX	4.9E+02	NA	NA	NA	
RDX	3.2E+03	3.0E-07	1.1E-01	3.3E-08	
			Pathway Total:	3.3E-08	66%
Dermal Contact with Surface Soil					
Barium	2.8E+03	NA	NA	NA	
HMX	4.9E+02	NA	NA	NA	
RDX	3.2E+03	1.5E-07	1.1E-01	1.7E-08	
			Pathway Total:	1.7E-08	33%
Inhalation of Particulates					
Arsenic	5.8E-07	2.7E-11	1.5E+01	4.0E-10	
Barium	7.0E-06	NA	NA	NA	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	4.0E-10	1%
			Total CTE ILCR:	5.1E-08	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Barium	2.8E+03	NA	NA	NA	
HMX	4.9E+02	NA	NA	NA	
RDX	3.2E+03	2.4E-04	1.1E-01	2.7E-05	
			Pathway Total:	2.7E-05	46%
Dermal Contact with Surface Soil					
Barium	2.8E+03	NA	NA	NA	
HMX	4.9E+02	NA	NA	NA	
RDX	3.2E+03	2.8E-04	1.1E-01	3.1E-05	
			Pathway Total:	3.1E-05	54%
Inhalation of Particulates					
Arsenic	5.8E-07	6.4E-09	1.5E+01	9.6E-08	
Barium	7.0E-06	NA	NA	NA	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	9.6E-08	0%
			Total RME ILCR:	5.8E-05	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-65. Summary of Potential Carcinogenic Risk Results for the Future On-Site Adult Resident for SWMU 40 (Hot Spot in Vicinity of Test Pit ARP-94-48)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) (mg/kg-day)-1	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Barium	2.8E+03	NA(d)	NA	NA	
HMX	4.9E+02	NA	NA	NA	
RDX	3.2E+03	2.8E-05	1.1E-01	3.1E-06	
			Pathway Total:	3.1E-06	0%
Dermal Contact with Surface Soil					
Barium	2.8E+03	NA	NA	NA	
HMX	4.9E+02	NA	NA	NA	
RDX	3.2E+03	1.4E-05	1.1E-01	1.5E-06	
			Pathway Total:	1.5E-06	0%
Inhalation of Particulates					
Arsenic	5.8E-07	2.1E-09	1.5E+01	3.2E-08	
Barium	7.0E-06	NA	NA	NA	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	3.2E-08	0%
Ingestion of Leafy Vegetables					
Barium	9.2E+01	NA	NA	NA	
HMX	8.3E+02	NA	NA	NA	
RDX	7.7E+03	1.1E-01	1.1E-01	1.3E-02	
			Pathway Total:	1.3E-02	1%
Ingestion of Tubers and Fruits					
Barium	9.2E+00	NA	NA	NA	
HMX	2.9E+04	NA	NA	NA	
RDX	2.7E+05	1.4E+01	1.1E-01	1.5E+00	
			Pathway Total:	1.5E+00	99%
			Total CTE ILCR:	1.5E+00	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Barium	2.8E+03	NA	NA	NA	
HMX	4.9E+02	NA	NA	NA	
RDX	3.2E+03	6.7E-04	1.1E-01	7.3E-05	
			Pathway Total:	7.3E-05	0%
Dermal Contact with Surface Soil					
Barium	2.8E+03	NA	NA	NA	
HMX	4.9E+02	NA	NA	NA	
RDX	3.2E+03	7.7E-04	1.1E-01	8.5E-05	
			Pathway Total:	8.5E-05	0%
Inhalation of Particulates					
Arsenic	5.8E-07	1.1E-08	1.5E+01	1.7E-07	
Barium	7.0E-06	NA	NA	NA	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	1.7E-07	0%
Ingestion of Leafy Vegetables					
Barium	9.2E+01	NA	NA	NA	
HMX	8.3E+02	NA	NA	NA	
RDX	7.7E+03	1.5E+00	1.1E-01	1.7E-01	
			Pathway Total:	1.7E-01	1%
Ingestion of Tubers and Fruits					
Barium	9.2E+00	NA	NA	NA	
HMX	2.9E+04	NA	NA	NA	
RDX	2.7E+05	1.8E+02	1.1E-01	2.0E+01	
			Pathway Total:	2.0E+01	99%
			Total RME ILCR:	2.0E+01	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-66. Summary of Potential Carcinogenic Risk Results for the Future On-Site Child Resident for SWMU 40 (Hot Spot in Vicinity of Test Pit ARP-94-48)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) (mg/kg-day)$^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Barium	2.8E+03	NA(d)	NA	NA	
HMX	4.9E+02	NA	NA	NA	
RDX	3.2E+03	1.3E-04	1.1E-01	1.4E-05	
			Pathway Total:	1.4E-05	0%
Dermal Contact with Surface Soil					
Barium	2.8E+03	NA	NA	NA	
HMX	4.9E+02	NA	NA	NA	
RDX	3.2E+03	2.4E-05	1.1E-01	2.6E-06	
			Pathway Total:	2.6E-06	0%
Inhalation of Particulates					
Arsenic	5.8E-07	1.1E-08	1.5E+01	1.6E-07	
Barium	7.0E-06	NA	NA	NA	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	1.6E-07	0%
Ingestion of Leafy Vegetables					
Barium	9.2E+01	NA	NA	NA	
HMX	8.3E+02	NA	NA	NA	
RDX	7.7E+03	1.9E-01	1.1E-01	2.1E-02	
			Pathway Total:	2.1E-02	1%
Ingestion of Tubers and Fruits					
Barium	9.2E+00	NA	NA	NA	
HMX	2.9E+04	NA	NA	NA	
RDX	2.7E+05	2.2E+01	1.1E-01	2.4E+00	
			Pathway Total:	2.4E+00	99%
			Total CTE ILCR:	2.4E+00	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Barium	2.8E+03	NA	NA	NA	
HMX	4.9E+02	NA	NA	NA	
RDX	3.2E+03	1.4E-03	1.1E-01	1.6E-04	
			Pathway Total:	1.6E-04	0%
Dermal Contact with Surface Soil					
Barium	2.8E+03	NA	NA	NA	
HMX	4.9E+02	NA	NA	NA	
RDX	3.2E+03	3.2E-04	1.1E-01	3.6E-05	
			Pathway Total:	3.6E-05	0%
Inhalation of Particulates					
Arsenic	5.8E-07	1.8E-08	1.5E+01	2.6E-07	
Barium	7.0E-06	NA	NA	NA	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	2.6E-07	0%
Ingestion of Leafy Vegetables					
Barium	9.2E+01	NA	NA	NA	
HMX	8.3E+02	NA	NA	NA	
RDX	7.7E+03	9.9E-01	1.1E-01	1.1E-01	
			Pathway Total:	1.1E-01	1%
Ingestion of Tubers and Fruits					
Barium	9.2E+00	NA	NA	NA	
HMX	2.9E+04	NA	NA	NA	
RDX	2.7E+05	1.2E+02	1.1E-01	1.3E+01	
			Pathway Total:	1.3E+01	99%
			Total RME ILCR:	1.3E+01	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-67. Summary of Potential Carcinogenic Risk Results for the Current/Future On-Site Laborer for SWMU 40 (Remainder of SWMU)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.1E+01	1.1E-09	1.5E+00	1.6E-09	
1,3,5-Trinitrotoluene	5.1E-01	NA(d)	NA	NA	
			Pathway Total:	1.6E-09	77%
Dermal Contact with Surface Soil					
Arsenic	1.1E+01	5.4E-11	1.5E+00	8.3E-11	
1,3,5-Trinitrotoluene	5.1E-01	NA	NA	NA	
			Pathway Total:	8.3E-11	4%
Inhalation of Particulates					
Arsenic	5.8E-07	2.7E-11	1.5E+01	4.0E-10	
Barium	7.0E-06	NA	NA	NA	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	4.0E-10	19%
			Total CTE ILCR:	2.1E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.1E+01	8.7E-07	1.5E+00	1.3E-06	
1,3,5-Trinitrotoluene	5.1E-01	NA	NA	NA	
			Pathway Total:	1.3E-06	84%
Dermal Contact with Surface Soil					
Arsenic	1.1E+01	1.0E-07	1.5E+00	1.5E-07	
1,3,5-Trinitrotoluene	5.1E-01	NA	NA	NA	
			Pathway Total:	1.5E-07	10%
Inhalation of Particulates					
Arsenic	5.8E-07	6.4E-09	1.5E+01	9.6E-08	
Barium	7.0E-06	NA	NA	NA	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	9.6E-08	6%
			Total RME ILCR:	1.6E-06	100%

[a] Units for the inhalation pathway are mg/m^3.

[b] See Appendix L for sources and methodology on estimating a daily intake value.

[c] See Appendix M for sources and methodology of toxicity values.

[d] NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-68. Summary of Potential Carcinogenic Risk Results for the Future On-Site Adult Resident for SWMU 40 (Remainder of SWMU)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.1E+01	1.0E-07	1.5E+00	1.5E-07	
1,3,5-Trinitrotoluene	5.1E-01	NA[d]	NA	NA	
			Pathway Total:	1.5E-07	4%
Dermal Contact with Surface Soil					
Arsenic	1.1E+01	5.0E-09	1.5E+00	7.6E-09	
1,3,5-Trinitrotoluene	5.1E-01	NA	NA	NA	
			Pathway Total:	7.6E-09	0%
Inhalation of Particulates					
Arsenic	5.8E-07	2.1E-09	1.5E+01	3.2E-08	
Barium	7.0E-06	NA	NA	NA	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	3.2E-08	1%
Ingestion of Leafy Vegetables					
Arsenic	1.0E-01	1.4E-06	1.5E+00	2.1E-06	
1,3,5-Trinitrotoluene	2.0E-01	NA	NA	NA	
			Pathway Total:	2.1E-06	61%
Ingestion of Tubers and Fruits					
Arsenic	1.5E-02	7.5E-07	1.5E+00	1.1E-06	
1,3,5-Trinitrotoluene	6.9E+00	NA	NA	NA	
			Pathway Total:	1.1E-06	33%
			Total CTE ILCR:	3.4E-06	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.1E+01	2.4E-06	1.5E+00	3.6E-06	
1,3,5-Trinitrotoluene	5.1E-01	NA	NA	NA	
			Pathway Total:	3.6E-06	7%
Dermal Contact with Surface Soil					
Arsenic	1.1E+01	2.8E-07	1.5E+00	4.2E-07	
1,3,5-Trinitrotoluene	5.1E-01	NA	NA	NA	
			Pathway Total:	4.2E-07	1%
Inhalation of Particulates					
Arsenic	5.8E-07	1.1E-08	1.5E+01	1.7E-07	
Barium	7.0E-06	NA	NA	NA	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	1.7E-07	0%
Ingestion of Leafy Vegetables					
Arsenic	1.0E-01	2.0E-05	1.5E+00	2.9E-05	
1,3,5-Trinitrotoluene	2.0E-01	NA	NA	NA	
			Pathway Total:	2.9E-05	61%
Ingestion of Tubers and Fruits					
Arsenic	1.5E-02	9.9E-06	1.5E+00	1.5E-05	
1,3,5-Trinitrotoluene	6.9E+00	NA	NA	NA	
			Pathway Total:	1.5E-05	31%
			Total RME ILCR:	4.8E-05	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens

Table 6-69. Summary of Potential Carcinogenic Risk Results for the Future On-Site Child Resident for SWMU 40 (Remainder of SWMU)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Carcinogenic Intake[b] (mg/kg-day)	Carcinogenic Slope Factor[c] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.1E+01	4.5E-07	1.5E+00	6.8E-07	
1,3,5-Trinitrotoluene	5.1E-01	NA[d]	NA	NA	
			Pathway Total:	6.8E-07	11%
Dermal Contact with Surface Soil					
Arsenic	1.1E+01	8.4E-09	1.5E+00	1.3E-08	
1,3,5-Trinitrotoluene	5.1E-01	NA	NA	NA	
			Pathway Total:	1.3E-08	0%
Inhalation of Particulates					
Arsenic	5.8E-07	1.1E-08	1.5E+01	1.6E-07	
Barium	7.0E-06	NA	NA	NA	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	1.6E-07	3%
Ingestion of Leafy Vegetables					
Arsenic	1.0E-01	2.4E-06	1.5E+00	3.6E-06	
1,3,5-Trinitrotoluene	2.0E-01	NA	NA	NA	
			Pathway Total:	3.6E-06	58%
Ingestion of Tubers and Fruits					
Arsenic	1.5E-02	1.2E-06	1.5E+00	1.8E-06	
1,3,5-Trinitrotoluene	6.9E+00	NA	NA	NA	
			Pathway Total:	1.8E-06	29%
			Total CTE ILCR:	6.3E-06	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.1E+01	5.1E-06	1.5E+00	7.6E-06	
1,3,5-Trinitrotoluene	5.1E-01	NA	NA	NA	
			Pathway Total:	7.6E-06	20%
Dermal Contact with Surface Soil					
Arsenic	1.1E+01	1.2E-07	1.5E+00	1.8E-07	
1,3,5-Trinitrotoluene	5.1E-01	NA	NA	NA	
			Pathway Total:	1.8E-07	0%
Inhalation of Particulates					
Arsenic	5.8E-07	1.8E-08	1.5E+01	2.6E-07	
Barium	7.0E-06	NA	NA	NA	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	2.6E-07	1%
Ingestion of Leafy Vegetables					
Arsenic	1.0E-01	1.3E-05	1.5E+00	1.9E-05	
1,3,5-Trinitrotoluene	2.0E-01	NA	NA	NA	
			Pathway Total:	1.9E-05	52%
Ingestion of Tubers and Fruits					
Arsenic	1.5E-02	6.5E-06	1.5E+00	9.7E-06	
1,3,5-Trinitrotoluene	6.9E+00	NA	NA	NA	
			Pathway Total:	9.7E-06	26%
			Total RME ILCR:	3.7E-05	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-70. Summary of Carcinogenic Risk Results for the Future Construction Worker for SWMU 40 (Remainder of SWMU)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Carcinogenic Intake(b) (mg/kg-day)	Carcinogenic Slope Factor(c) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Subsurface Soil					
Arsenic	7.6E+00	5.5E-08	1.5E+00	8.3E-08	
			Pathway Total:	8.3E-08	65%
Dermal Contact with Subsurface Soil					
Arsenic	7.6E+00	2.0E-10	1.5E+00	3.0E-10	
			Pathway Total:	3.0E-10	0%
Inhalation of Particulates					
Arsenic	3.1E-05	3.0E-09	1.5E+01	4.5E-08	
			Pathway Total:	4.5E-08	35%
			Total CTE ILCR:	1.3E-07	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Subsurface Soil					
Arsenic	7.6E+00	7.7E-07	1.5E+00	1.2E-06	
			Pathway Total:	1.2E-06	65%
Dermal Contact with Subsurface Soil					
Arsenic	7.6E+00	1.4E-08	1.5E+00	2.1E-08	
			Pathway Total:	2.1E-08	1%
Inhalation of Particulates					
Arsenic	3.1E-05	4.0E-08	1.5E+01	5.9E-07	
			Pathway Total:	5.9E-07	33%
			Total RME ILCR:	1.8E-06	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

Table 6-71. Summary of Potential Carcinogenic Risk Results for the Current/Future On-Site Laborer for SWMU 40 as a Whole

Chemical	Exposure Point Concentration (mg/kg)[(a)]	Daily Carcinogenic Intake[(b)] (mg/kg-day)	Carcinogenic Slope Factor[(c)] (mg/kg-day)$^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.1E+01	1.0E-09	1.5E+00	1.6E-09	
Barium	1.3E+02	NA[(d)]	NA	NA	
Lead	3.2E+01	NA	NA	NA	
1,3,5-Tritrobenzene	4.9E-01	NA	NA	NA	
HMX	2.2E+00	NA	NA	NA	
RDX	3.4E+00	3.2E-10	1.1E-01	3.6E-11	
			Pathway Total:	1.6E-09	76%
Dermal Contact with Surface Soil					
Arsenic	1.1E+01	5.2E-11	1.5E+00	8.0E-11	
Barium	1.3E+02	NA	NA	NA	
Lead	3.2E+01	NA	NA	NA	
1,3,5-Tritrobenzene	4.9E-01	NA	NA	NA	
HMX	2.2E+00	NA	NA	NA	
RDX	3.4E+00	1.6E-10	1.1E-01	1.8E-11	
			Pathway Total:	9.8E-11	5%
Inhalation of Particulates					
Arsenic	5.8E-07	2.7E-11	1.5E+01	4.0E-10	
Barium	7.0E-06	NA	NA	NA	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	4.0E-10	19%
			Total CTE ILCR:	2.1E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.1E+01	8.4E-07	1.5E+00	1.3E-06	
Barium	1.3E+02	NA	NA	NA	
Lead	3.2E+01	NA	NA	NA	
1,3,5-Tritrobenzene	4.9E-01	NA	NA	NA	
HMX	2.2E+00	NA	NA	NA	
RDX	3.4E+00	2.6E-07	1.1E-01	2.8E-08	
			Pathway Total:	1.3E-06	82%
Dermal Contact with Surface Soil					
Arsenic	1.1E+01	9.7E-08	1.5E+00	1.5E-07	
Barium	1.3E+02	NA	NA	NA	
Lead	3.2E+01	NA	NA	NA	
1,3,5-Tritrobenzene	4.9E-01	NA	NA	NA	
HMX	2.2E+00	NA	NA	NA	
RDX	3.4E+00	3.0E-07	1.1E-01	3.3E-08	
			Pathway Total:	1.8E-07	12%
Inhalation of Particulates					
Arsenic	5.8E-07	6.4E-09	1.5E+01	9.6E-08	
Barium	7.0E-06	NA	NA	NA	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	9.6E-08	6%
			Total RME ILCR:	1.6E-06	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-72. Summary of Potential Carcinogenic Risk Results for the Current Off-Site Adult Resident for SWMU 40 as a Whole

Chemical	Exposure Point Concentration (mg/m^3)	Daily Carcinogenic Intake(a) (mg/kg-day)	Carcinogenic Slope Factor(b) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Inhalation of Particulates					
Arsenic	3.2E-07	1.2E-09	1.5E+01	1.7E-08	
Barium	3.9E-06	NA(c)	NA	NA	
Lead	9.2E-07	NA	NA	NA	
1,3,5-Trinitrobenzene	1.4E-08	NA	NA	NA	
HMX	6.4E-08	NA	NA	NA	
RDX	9.8E-08	NA	NA	NA	
			Total CTE ILCR:	1.7E-08	100%
Reasonable Maximum Exposure (RME) Scenario					
Inhalation of Particulates					
Arsenic	3.2E-07	6.1E-09	1.5E+01	9.2E-08	
Barium	3.9E-06	NA	NA	NA	
Lead	9.2E-07	NA	NA	NA	
1,3,5-Trinitrobenzene	1.4E-08	NA	NA	NA	
HMX	6.4E-08	NA	NA	NA	
RDX	9.8E-08	NA	NA	NA	
			Total RME ILCR:	9.2E-08	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.

[b]See Appendix M for sources and methodology of toxicity values.

[c]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-73. Summary of Potential Carcinogenic Risk Results for the Current Off-Site Child Resident for SWMU 40 as a Whole

Chemical	Exposure Point Concentration (mg/m^3)	Daily Carcinogenic Intake(a) (mg/kg-day)	Carcinogenic Slope Factor(b) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Inhalation of Particulates					
Arsenic	3.2E-07	6.0E-09	1.5E+01	8.9E-08	
Barium	3.9E-06	NA[c]	NA	NA	
Lead	9.2E-07	NA	NA	NA	
1,3,5-Trinitrobenzene	1.4E-08	NA	NA	NA	
HMX	6.4E-08	NA	NA	NA	
RDX	9.8E-08	NA	NA	NA	
			Total CTE ILCR:	8.9E-08	100%
Reasonable Maximum Exposure (RME) Scenario					
Inhalation of Particulates					
Arsenic	3.2E-07	9.7E-09	1.5E+01	1.4E-07	
Barium	3.9E-06	NA	NA	NA	
Lead	9.2E-07	NA	NA	NA	
1,3,5-Trinitrobenzene	1.4E-08	NA	NA	NA	
HMX	6.4E-08	NA	NA	NA	
RDX	9.8E-08	NA	NA	NA	
			Total RME ILCR:	1.4E-07	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.

[b]See Appendix M for sources and methodology of toxicity values.

[c]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-74. Summary of Carcinogenic Risk Results for the Current Adult Beef Consumer for Grazing Allotment 3 (SWMU 40)

Chemical	Exposure Point Concentration (mg/kg)	Daily Carcinogenic Intake[a] (mg/kg-day)	Carcinogenic Slope Factor[b] $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Beef					
Arsenic	1.4E-04	3.7E-09	1.5E+00	5.6E-09	
Barium	2.5E-04	NA[c]	NA	NA	
Lead	2.2E-05	NA	NA	NA	
1,3,5-Trinitrobenzene	3.2E-07	NA	NA	NA	
HMX	4.7E-07	NA	NA	NA	
RDX	5.6E-07	1.5E-11	1.1E-01	1.6E-12	
			Total CTE ILCR:	5.6E-09	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Beef					
Arsenic	1.4E-04	5.7E-08	1.5E+00	8.5E-08	
Barium	2.5E-04	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
1,3,5-Trinitrobenzene	3.2E-07	NA	NA	NA	
HMX	4.7E-07	NA	NA	NA	
RDX	5.6E-07	2.2E-10	1.1E-01	2.5E-11	
			Total RME ILCR:	8.5E-08	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.

[b]See Appendix M for sources and methodology of toxicity values.

[c]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-75. Summary of Carcinogenic Risk Results for the Current Child Beef Consumer for Grazing Allotment 3 (SWMU 40)

Chemical	Exposure Point Concentration (mg/kg)	Daily Carcinogenic Intake(a) (mg/kg-day)	Carcinogenic Slope Factor(b) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Beef					
Arsenic	1.4E-04	8.2E-09	1.5E+00	1.2E-08	
Barium	2.5E-04	NA(c)	NA	NA	
Lead	2.2E-05	NA	NA	NA	
1,3,5-Trinitrobenzene	3.2E-07	NA	NA	NA	
HMX	4.7E-07	NA	NA	NA	
RDX	5.6E-07	3.2E-11	1.1E-01	3.6E-12	
			Total CTE ILCR:	1.2E-08	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Beef					
Arsenic	1.4E-04	5.2E-08	1.5E+00	7.8E-08	
Barium	2.5E-04	NA	NA	NA	
Lead	2.2E-05	NA	NA	NA	
1,3,5-Trinitrobenzene	3.2E-07	NA	NA	NA	
HMX	4.7E-07	NA	NA	NA	
RDX	5.6E-07	2.1E-10	1.1E-01	2.3E-11	
			Total RME ILCR:	7.8E-08	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.

[b]See Appendix M for sources and methodology of toxicity values.

[c]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-76. Summary of Potential Carcinogenic Risk Results for the Ingestion of Groundwater Pathway by the Future On-Site Adult Resident for SWMU 40

Chemical	Exposure Point Concentration (mg/L)	Daily Carcinogenic Intake(a) (mg/kg-day)	Carcinogenic Slope Factor(b) $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk (ILCR)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
<u>Ingestion of Groundwater</u>					
HMX	8.4E-01	NA[c]	NA	NA	
RDX	4.1E+00	5.1E-03	1.1E-01	5.6E-04	
2,4-Dinitrotoluene	2.5E-01	3.1E-04	6.8E-01	2.1E-04	
Tetryl	2.9E-01	NA	NA	NA	
			Total CTE ILCR:	7.7E-04	100%
Reasonable Maximum Exposure (RME) Scenario					
<u>Ingestion of Groundwater</u>					
HMX	8.4E-01	NA	NA	NA	
RDX	4.1E+00	3.4E-02	1.1E-01	3.8E-03	
2,4-Dinitrotoluene	2.5E-01	2.1E-03	6.8E-01	1.4E-03	
Tetryl	2.9E-01	NA	NA	NA	
			Total RME ILCR:	5.2E-03	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.

[b]See Appendix M for sources and methodology of toxicity values.

[c]NA denotes not applicable. These COPC were not quantitatively included because they are not classified as carcinogens.

Table 6-77. Summary of Potential Systemic Effects for the Current/Future On-Site Laborer for SWMU 40 (Hot Spot Near Old Furnace Building)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.3E+01	3.0E-08	3.0E-04	1.0E-04	
Lead	4.0E+02	NA(d)	NA	NA	
			Pathway Total:	1.0E-04	73%
Dermal Contact with Surface Soil					
Arsenic	1.3E+01	1.5E-09	2.9E-04	5.2E-06	
Lead	4.0E+02	NA	NA	NA	
			Pathway Total:	5.2E-06	4%
Inhalation of Particulates					
Arsenic	3.3E-07	NA	NA	NA	
Barium	4.0E-06	4.6E-09	1.4E-04	3.2E-05	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	1.5E-08	NA	NA	NA	
HMX	6.7E-08	NA	NA	NA	
RDX	1.0E-07	NA	NA	NA	
			Pathway Total:	3.2E-05	23%
			Total CTE HI:	1.4E-04	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.3E+01	2.9E-06	3.0E-04	9.7E-03	
Lead	4.0E+02	NA	NA	NA	
			Pathway Total:	9.7E-03	82%
Dermal Contact with Surface Soil					
Arsenic	1.3E+01	3.4E-07	2.9E-04	1.2E-03	
Lead	4.0E+02	NA	NA	NA	
			Pathway Total:	1.2E-03	10%
Inhalation of Particulates					
Arsenic	3.3E-07	NA	NA	NA	
Barium	4.0E-06	1.3E-07	1.4E-04	9.3E-04	
Lead	1.4E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	1.5E-08	NA	NA	NA	
HMX	6.7E-08	NA	NA	NA	
RDX	1.0E-07	NA	NA	NA	
			Pathway Total:	9.3E-04	8%
			Total RME HI:	1.2E-02	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-78. Summary of Potential Systemic Effects for the Future On-Site Adult Resident for SWMU 40 (Hot Spot Near Old Furnace Building)

Chemical	Exposure Point Concentration (mg/kg)[(a)]	Daily Noncarcinogenic Intake[(b)] (mg/kg-day)	Chronic RfD[(c)] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.3E+01	1.0E-06	3.0E-04	3.5E-03	
Lead	4.0E+02	NA[(d)]	NA	NA	
			Pathway Total:	3.5E-03	4%
Dermal Contact with Surface Soil					
Arsenic	1.3E+01	5.2E-08	2.9E-04	1.8E-04	
Lead	4.0E+02	NA	NA	NA	
			Pathway Total:	1.8E-04	0%
Inhalation of Particulates					
Arsenic	3.3E-07	NA	NA	NA	
Barium	4.0E-06	1.4E-07	1.4E-04	9.6E-04	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	1.5E-08	NA	NA	NA	
HMX	6.7E-08	NA	NA	NA	
RDX	1.0E-07	NA	NA	NA	
			Pathway Total:	9.6E-04	1%
Ingestion of Leafy Vegetables					
Arsenic	1.1E-01	1.6E-05	3.0E-04	5.2E-02	
Lead	1.3E+00	NA	NA	NA	
			Pathway Total:	5.2E-02	63%
Ingestion of Tubers and Fruits					
Arsenic	1.7E-02	7.9E-06	3.0E-04	2.6E-02	
Lead	8.0E-01	NA	NA	NA	
			Pathway Total:	2.6E-02	32%
			Total CTE HI:	8.3E-02	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.3E+01	6.6E-06	3.0E-04	2.2E-02	
Lead	4.0E+02	NA	NA	NA	
			Pathway Total:	2.2E-02	7%
Dermal Contact with Surface Soil					
Arsenic	1.3E+01	7.7E-07	2.9E-04	2.6E-03	
Lead	4.0E+02	NA	NA	NA	
			Pathway Total:	2.6E-03	1%
Inhalation of Particulates					
Arsenic	3.3E-07	NA	NA	NA	
Barium	4.0E-06	1.9E-07	1.4E-04	1.4E-03	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	1.5E-08	NA	NA	NA	
HMX	6.7E-08	NA	NA	NA	
RDX	1.0E-07	NA	NA	NA	
			Pathway Total:	1.4E-03	0%
Ingestion of Leafy Vegetables					
Arsenic	1.1E-01	5.5E-05	3.0E-04	1.8E-01	
Lead	1.3E+00	NA	NA	NA	
			Pathway Total:	1.8E-01	61%
Ingestion of Tubers and Fruits					
Arsenic	1.7E-02	2.8E-05	3.0E-04	9.2E-02	
Lead	8.0E-01	NA	NA	NA	
			Pathway Total:	9.2E-02	31%
			Total RME HI:	3.0E-01	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-79. Summary of Potential Systemic Effects for the Future On-Site Child Resident for SWMU 40 (Hot Spot Near Old Furnace Buildings)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.3E+01	4.7E-06	3.0E-04	1.6E-02	
Lead	4.0E+02	NA(d)	NA	NA	
			Pathway Total:	1.6E-02	10%
Dermal Contact with Surface Soil					
Arsenic	1.3E+01	8.8E-08	2.9E-04	3.0E-04	
Lead	4.0E+02	NA	NA	NA	
			Pathway Total:	3.0E-04	0%
Inhalation of Particulates					
Arsenic	5.8E-07	NA	NA	NA	
Barium	7.0E-06	1.2E-06	1.4E-04	8.5E-03	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	8.5E-03	6%
Ingestion of Leafy Vegetables					
Arsenic	1.1E-01	2.5E-05	3.0E-04	8.5E-02	
Lead	1.3E+00	NA	NA	NA	
			Pathway Total:	8.5E-02	56%
Ingestion of Tubers and Fruits					
Arsenic	1.7E-02	1.3E-05	3.0E-04	4.3E-02	
Lead	8.0E-01	NA	NA	NA	
			Pathway Total:	4.3E-02	28%
			Total CTE HI:	1.5E-01	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.3E+01	2.3E-05	3.0E-04	7.8E-02	
Lead	4.0E+02	NA	NA	NA	
			Pathway Total:	7.8E-02	20%
Dermal Contact with Surface Soil					
Arsenic	1.3E+01	5.4E-07	2.9E-04	1.8E-03	
Lead	4.0E+02	NA	NA	NA	
			Pathway Total:	1.8E-03	0%
Inhalation of Particulates					
Arsenic	5.8E-07	NA	NA	NA	
Barium	7.0E-06	8.8E-07	1.4E-04	6.2E-03	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	6.2E-03	2%
Ingestion of Leafy Vegetables					
Arsenic	1.1E-01	6.0E-05	3.0E-04	2.0E-01	
Lead	1.3E+00	NA	NA	NA	
			Pathway Total:	2.0E-01	52%
Ingestion of Tubers and Fruits					
Arsenic	1.7E-02	3.0E-05	3.0E-04	1.0E-01	
Lead	8.0E-01	NA	NA	NA	
			Pathway Total:	1.0E-01	26%
			Total RME HI:	3.9E-01	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-80. Summary of Potential Systemic Effects for the Current/Future On-Site Laborer for SWMU 40 (Hot Spot in Vicinity of Test Pit ARP-94-48)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Barium	2.8E+03	6.7E-06	7.0E-02	9.5E-05	
HMX	4.9E+02	1.2E-06	5.0E-02	2.3E-05	
RDX	3.2E+03	7.6E-06	3.0E-03	2.5E-03	
			Pathway Total:	2.7E-03	66%
Dermal Contact with Surface Soil					
Barium	2.8E+03	3.3E-07	7.0E-02	4.8E-06	
HMX	4.9E+02	5.8E-07	5.0E-02	1.2E-05	
RDX	3.2E+03	3.8E-06	3.0E-03	1.3E-03	
			Pathway Total:	1.3E-03	32%
Inhalation of Particulates					
Arsenic	5.8E-07	NA(d)	NA	NA	
Barium	7.0E-06	8.0E-09	1.4E-04	5.6E-05	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	5.6E-05	1%
			Total CTE HI:	4.0E-03	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Barium	2.8E+03	6.4E-04	7.0E-02	9.1E-03	
HMX	4.9E+02	1.1E-04	5.0E-02	2.2E-03	
RDX	3.2E+03	7.3E-04	3.0E-03	2.4E-01	
			Pathway Total:	2.5E-01	47%
Dermal Contact with Surface Soil					
Barium	2.8E+03	7.4E-05	7.0E-02	1.1E-03	
HMX	4.9E+02	1.3E-04	5.0E-02	2.6E-03	
RDX	3.2E+03	8.5E-04	3.0E-03	2.8E-01	
			Pathway Total:	2.9E-01	53%
Inhalation of Particulates					
Arsenic	5.8E-07	NA	NA	NA	
Barium	7.0E-06	2.3E-07	1.4E-04	1.6E-03	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	1.6E-03	0%
			Total RME HI:	5.4E-01	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-81. Summary of Potential Systemic Effects for the Future On-Site Adult Resident for SWMU 40 (Hot Spot in Vicinity of Test Pit ARP-94-48)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Barium	2.8E+03	2.3E-04	7.0E-02	3.3E-03	
HMX	4.9E+02	4.0E-05	5.0E-02	8.0E-04	
RDX	3.2E+03	2.6E-04	3.0E-03	8.8E-02	
			Pathway Total:	9.2E-02	0%
Dermal Contact with Surface Soil					
Barium	2.8E+03	1.2E-05	7.0E-02	1.6E-04	
HMX	4.9E+02	2.0E-05	5.0E-02	4.0E-04	
RDX	3.2E+03	1.3E-04	3.0E-03	4.4E-02	
			Pathway Total:	4.4E-02	0%
Inhalation of Particulates					
Arsenic	5.8E-07	NA[d]	NA	NA	
Barium	7.0E-06	2.4E-07	1.4E-04	1.7E-03	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	1.7E-03	0%
Ingestion of Leafy Vegetables					
Barium	9.2E+01	1.3E-02	7.0E-02	1.8E-01	
HMX	8.3E+02	1.2E-01	5.0E-02	2.3E+00	
RDX	7.7E+03	1.1E+00	3.0E-03	3.6E+02	
			Pathway Total:	3.6E+02	1%
Ingestion of Tubers and Fruits					
Barium	9.2E+00	4.3E-03	7.0E-02	6.2E-02	
HMX	2.9E+04	1.4E+01	5.0E-02	2.7E+02	
RDX	2.7E+05	1.3E+02	3.0E-03	4.2E+04	
			Pathway Total:	4.3E+04	99%
			Total CTE HI:	4.3E+04	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Barium	2.8E+03	1.5E-03	7.0E-02	2.1E-02	
HMX	4.9E+02	2.5E-04	5.0E-02	5.0E-03	
RDX	3.2E+03	1.7E-03	3.0E-03	5.5E-01	
			Pathway Total:	5.8E-01	0%
Dermal Contact with Surface Soil					
Barium	2.8E+03	1.7E-04	7.0E-02	2.4E-03	
HMX	4.9E+02	2.9E-04	5.0E-02	5.9E-03	
RDX	3.2E+03	1.9E-03	3.0E-03	6.4E-01	
			Pathway Total:	6.5E-01	0%
Inhalation of Particulates					
Arsenic	5.8E-07	NA	NA	NA	
Barium	7.0E-06	3.4E-07	1.4E-04	2.3E-03	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	2.3E-03	0%
Ingestion of Leafy Vegetables					
Barium	9.2E+01	4.5E-02	7.0E-02	6.5E-01	
HMX	8.3E+02	4.0E-01	5.0E-02	8.1E+00	
RDX	7.7E+03	3.8E+00	3.0E-03	1.3E+03	
			Pathway Total:	1.3E+03	1%
Ingestion of Tubers and Fruits					
Barium	9.2E+00	1.5E-02	7.0E-02	2.2E-01	
HMX	2.9E+04	4.8E+01	5.0E-02	9.5E+02	
RDX	2.7E+05	4.5E+02	3.0E-03	1.5E+05	
			Pathway Total:	1.5E+05	99%
			Total RME HI:	1.5E+05	100%

[a] Units for the inhalation pathway are mg/m3.
[b] See Appendix L for sources and methodology on estimating a daily intake value.
[c] See Appendix M for sources and methodology of toxicity values.
[d] NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-82. Summary of Potential Systemic Effects for the Future On-Site Child Resident for SWMU 40 (Hot Spot in Vicinity of Test Pit ARP-94-48)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Barium	2.8E+03	1.0E-03	7.0E-02	1.5E-02	
HMX	4.9E+02	1.8E-04	5.0E-02	3.6E-03	
RDX	3.2E+03	1.2E-03	3.0E-03	4.0E-01	
			Pathway Total:	4.2E-01	0%
Dermal Contact with Surface Soil					
Barium	2.8E+03	1.9E-05	7.0E-02	2.8E-04	
HMX	4.9E+02	3.4E-05	5.0E-02	6.7E-04	
RDX	3.2E+03	2.2E-04	3.0E-03	7.4E-02	
			Pathway Total:	7.5E-02	0%
Inhalation of Particulates					
Arsenic	5.8E-07	NA(d)	NA	NA	
Barium	7.0E-06	1.2E-06	1.4E-04	8.5E-03	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	8.5E-03	0%
Ingestion of Leafy Vegetables					
Barium	9.2E+01	2.1E-02	7.0E-02	3.0E-01	
HMX	8.3E+02	1.9E-01	5.0E-02	3.8E+00	
RDX	7.7E+03	1.8E+00	3.0E-03	5.8E+02	
			Pathway Total:	5.9E+02	1%
Ingestion of Tubers and Fruits					
Barium	9.2E+00	7.1E-03	7.0E-02	1.0E-01	
HMX	2.9E+04	2.2E+01	5.0E-02	4.4E+02	
RDX	2.7E+05	2.1E+02	3.0E-03	6.9E+04	
			Pathway Total:	6.9E+04	99%
			Total CTE HI:	7.0E+04	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Barium	2.8E+03	5.2E-03	7.0E-02	7.4E-02	
HMX	4.9E+02	9.0E-04	5.0E-02	1.8E-02	
RDX	3.2E+03	5.9E-03	3.0E-03	2.0E+00	
			Pathway Total:	2.1E+00	0%
Dermal Contact with Surface Soil					
Barium	2.8E+03	1.2E-04	7.0E-02	1.7E-03	
HMX	4.9E+02	2.0E-04	5.0E-02	4.1E-03	
RDX	3.2E+03	1.4E-03	3.0E-03	4.5E-01	
			Pathway Total:	4.6E-01	0%
Inhalation of Particulates					
Arsenic	5.8E-07	NA	NA	NA	
Barium	7.0E-06	8.8E-07	1.4E-04	6.2E-03	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	6.2E-03	0%
Ingestion of Leafy Vegetables					
Barium	9.2E+01	5.0E-02	7.0E-02	7.1E-01	
HMX	8.3E+02	4.4E-01	5.0E-02	8.9E+00	
RDX	7.7E+03	4.1E+00	3.0E-03	1.4E+03	
			Pathway Total:	1.4E+03	1%
Ingestion of Tubers and Fruits					
Barium	9.2E+00	1.7E-02	7.0E-02	2.4E-01	
HMX	2.9E+04	5.2E+01	5.0E-02	1.0E+03	
RDX	2.7E+05	4.9E+02	3.0E-03	1.6E+05	
			Pathway Total:	1.6E+05	99%
			Total RME HI:	1.6E+05	100%

(a) Units for the inhalation pathway are mg/m3.
(b) See Appendix L for sources and methodology on estimating a daily intake value.
(c) See Appendix M for sources and methodology of toxicity values.
(d) NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-83. Summary of Potential Systemic Effects for the Current/Future On-Site Laborer for SWMU 40 (Remainder of SWMU)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.1E+01	2.7E-08	3.0E-04	9.0E-05	
1,3,5-Trinitrotoluene	5.1E-01	1.2E-09	5.0E-04	2.4E-06	
			Pathway Total:	9.3E-05	60%
Dermal Contact with Surface Soil					
Arsenic	1.1E+01	1.4E-09	2.9E-04	4.7E-06	
1,3,5-Trinitrotoluene	5.1E-01	6.1E-11	2.5E-04	2.4E-07	
			Pathway Total:	4.9E-06	3%
Inhalation of Particulates					
Arsenic	5.8E-07	NA[d]	NA	NA	
Barium	7.0E-06	8.0E-09	1.4E-04	5.6E-05	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	5.6E-05	36%
			Total CTE HI:	1.5E-04	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.1E+01	2.6E-06	3.0E-04	8.7E-03	
1,3,5-Trinitrotoluene	5.1E-01	1.2E-07	5.0E-05	2.3E-03	
			Pathway Total:	1.1E-02	77%
Dermal Contact with Surface Soil					
Arsenic	1.1E+01	3.0E-07	2.9E-04	1.0E-03	
1,3,5-Trinitrotoluene	5.1E-01	1.4E-08	2.5E-05	5.4E-04	
			Pathway Total:	1.6E-03	11%
Inhalation of Particulates					
Arsenic	5.8E-07	NA	NA	NA	
Barium	7.0E-06	2.3E-07	1.4E-04	1.6E-03	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	1.6E-03	11%
			Total RME HI:	1.4E-02	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-84. Summary of Potential Systemic Effects for the Future On-Site Adult Resident for SWMU 40 (Remainder of SWMU)

Chemical	Exposure Point Concentration (mg/kg)(a)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.1E+01	9.4E-07	3.0E-04	3.1E-03	
1,3,5-Trinitrotoluene	5.1E-01	4.2E-08	5.0E-05	8.4E-04	
			Pathway Total:	4.0E-03	0%
Dermal Contact with Surface Soil					
Arsenic	1.1E+01	4.7E-08	2.9E-04	1.6E-04	
1,3,5-Trinitrotoluene	5.1E-01	2.1E-09	2.5E-05	8.4E-05	
			Pathway Total:	2.5E-04	0%
Inhalation of Particulates					
Arsenic	5.8E-07	NA(d)	NA	NA	
Barium	7.0E-06	2.4E-07	1.4E-04	1.7E-03	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	1.7E-03	0%
Ingestion of Leafy Vegetables					
Arsenic	1.0E-01	1.4E-05	3.0E-04	4.7E-02	
1,3,5-Trinitrotoluene	2.0E-01	2.8E-05	5.0E-05	5.6E-01	
			Pathway Total:	6.1E-01	1%
Ingestion of Tubers and Fruits					
Arsenic	1.5E-02	7.1E-06	3.0E-04	2.4E-02	
1,3,5-Trinitrotoluene	6.9E+00	3.2E-03	5.0E-05	6.4E+01	
			Pathway Total:	6.4E+01	99%
			Total CTE HI:	6.5E+01	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.1E+01	5.9E-06	3.0E-04	2.0E-02	
1,3,5-Trinitrotoluene	5.1E-01	2.7E-07	5.0E-05	5.3E-03	
			Pathway Total:	2.5E-02	0%
Dermal Contact with Surface Soil					
Arsenic	1.1E+01	6.9E-07	2.9E-04	2.4E-03	
1,3,5-Trinitrotoluene	5.1E-01	3.1E-08	2.5E-05	1.2E-03	
			Pathway Total:	3.6E-03	0%
Inhalation of Particulates					
Arsenic	5.8E-07	NA	NA	NA	
Barium	7.0E-06	3.4E-07	1.4E-04	2.3E-03	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	2.3E-03	0%
Ingestion of Leafy Vegetables					
Arsenic	1.0E-01	4.9E-05	3.0E-04	1.6E-01	
1,3,5-Trinitrotoluene	2.0E-01	9.8E-05	5.0E-05	2.0E+00	
			Pathway Total:	2.1E+00	1%
Ingestion of Tubers and Fruits					
Arsenic	1.5E-02	2.5E-05	3.0E-04	8.3E-02	
1,3,5-Trinitrotoluene	6.9E+00	1.1E-02	5.0E-05	2.3E+02	
			Pathway Total:	2.3E+02	99%
			Total RME HI:	2.3E+02	100%

[a]Units for the inhalation pathway are mg/m^3.
[b]See Appendix L for sources and methodology on estimating a daily intake value.
[c]See Appendix M for sources and methodology of toxicity values.
[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-85. Summary of Potential Systemic Effects for the Future On-Site Child Resident for SWMU 40 (Remainder of SWMU)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.1E+01	4.2E-06	3.0E-04	1.4E-02	
1,3,5-Trinitrotoluene	5.1E-01	1.9E-07	5.0E-05	3.8E-03	
			Pathway Total:	1.8E-02	0%
Dermal Contact with Surface Soil					
Arsenic	1.1E+01	7.9E-08	2.9E-04	2.7E-04	
1,3,5-Trinitrotoluene	5.1E-01	3.5E-09	2.5E-05	1.4E-04	
			Pathway Total:	4.1E-04	0%
Inhalation of Particulates					
Arsenic	5.8E-07	NA[d]	NA	NA	
Barium	7.0E-06	1.2E-06	1.4E-04	8.5E-03	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	8.5E-03	0%
Ingestion of Leafy Vegetables					
Arsenic	1.0E-01	2.3E-05	3.0E-04	7.6E-02	
1,3,5-Trinitrotoluene	2.0E-01	4.5E-05	5.0E-05	9.1E-01	
			Pathway Total:	9.8E-01	1%
Ingestion of Tubers and Fruits					
Arsenic	1.5E-02	1.1E-05	3.0E-04	3.8E-02	
1,3,5-Trinitrotoluene	6.9E+00	5.2E-03	5.0E-05	1.0E+02	
			Pathway Total:	1.0E+02	99%
			Total CTE HI:	1.1E+02	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.1E+01	2.1E-05	3.0E-04	7.0E-02	
1,3,5-Trinitrotoluene	5.1E-01	9.5E-07	5.0E-05	1.9E-02	
			Pathway Total:	8.9E-02	0%
Dermal Contact with Surface Soil					
Arsenic	1.1E+01	4.8E-07	2.9E-04	1.7E-03	
1,3,5-Trinitrotoluene	5.1E-01	2.2E-08	2.5E-05	8.7E-04	
			Pathway Total:	2.5E-03	0%
Inhalation of Particulates					
Arsenic	5.8E-07	NA	NA	NA	
Barium	7.0E-06	8.8E-07	1.4E-04	6.2E-03	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	6.2E-03	0%
Ingestion of Leafy Vegetables					
Arsenic	1.0E-01	5.4E-05	3.0E-04	1.8E-01	
1,3,5-Trinitrotoluene	2.0E-01	1.1E-04	5.0E-05	2.1E+00	
			Pathway Total:	2.3E+00	1%
Ingestion of Tubers and Fruits					
Arsenic	1.5E-02	2.7E-05	3.0E-04	9.0E-02	
1,3,5-Trinitrotoluene	6.9E+00	1.2E-02	5.0E-05	2.5E+02	
			Pathway Total:	2.5E+02	99%
			Total RME HI:	2.5E+02	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-86. Summary of Systemic Effects for the Future Construction Worker for SWMU 40 (Remainder of SWMU)

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Subsurface Soil					
Arsenic	7.6E+00	4.1E-06	3.0E-04	1.4E-02	
			Pathway Total:	1.4E-02	100%
Dermal Contact with Subsurface Soil					
Arsenic	7.6E+00	1.5E-08	2.9E-04	5.1E-05	
			Pathway Total:	5.1E-05	0%
Inhalation of Particulates					
Arsenic	3.1E-05	NA	NA	NA	
			Pathway Total:	NA	NA
			Total CTE HI:	1.4E-02	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Subsurface Soil					
Arsenic	7.6E+00	1.9E-05	3.0E-04	6.5E-02	
			Pathway Total:	6.5E-02	98%
Dermal Contact with Subsurface Soil					
Arsenic	7.6E+00	3.4E-07	2.9E-04	1.2E-03	
			Pathway Total:	1.2E-03	2%
Inhalation of Particulates					
Arsenic	3.1E-05	NA	NA	NA	
			Pathway Total:	NA	NA
			Total RME HI:	6.6E-02	100%

aUnits for the inhalation pathway are mg/m^3.

bSee Appendix L for sources and methodology on estimating a daily intake value.

cSee Appendix M for sources and methodology of toxicity values.

dNA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-87. Summary of Potential Systemic Effects for the Current/Future On-Site Laborer for SWMU 40 as a Whole

Chemical	Exposure Point Concentration (mg/kg)[a]	Daily Noncarcinogenic Intake[b] (mg/kg-day)	Chronic RfD[c] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Surface Soil					
Arsenic	1.1E+01	2.6E-08	3.0E-04	8.7E-05	
Barium	1.3E+02	3.2E-07	7.0E-02	4.5E-06	
Lead	3.2E+01	NA[d]	NA	NA	
1,3,5-Tritrobenzene	4.9E-01	1.2E-09	5.0E-04	2.3E-06	
HMX	2.2E+00	5.2E-09	5.0E-02	1.0E-07	
RDX	3.4E+00	8.1E-09	3.0E-03	2.7E-06	
			Pathway Total:	9.7E-05	59%
Dermal Contact with Surface Soil					
Arsenic	1.1E+01	1.3E-09	2.9E-04	4.5E-06	
Barium	1.3E+02	1.6E-08	7.0E-03	2.3E-06	
Lead	3.2E+01	NA	NA	NA	
1,3,5-Tritrobenzene	4.9E-01	5.8E-10	2.5E-04	2.3E-06	
HMX	2.2E+00	2.6E-09	1.5E-02	1.7E-07	
RDX	3.4E+00	4.0E-09	3.0E-03	1.3E-06	
			Pathway Total:	1.1E-05	6%
Inhalation of Particulates					
Arsenic	5.8E-07	NA	NA	NA	
Barium	7.0E-06	8.0E-09	1.4E-04	5.6E-05	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	5.6E-05	34%
			Total CTE HI:	1.6E-04	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Surface Soil					
Arsenic	1.1E+01	2.5E-06	3.0E-04	8.4E-03	
Barium	1.3E+02	3.0E-05	7.0E-02	4.3E-04	
Lead	3.2E+01	NA	NA	NA	
1,3,5-Tritrobenzene	4.9E-01	1.1E-07	5.0E-05	2.2E-03	
HMX	2.2E+00	5.0E-07	5.0E-02	1.0E-05	
RDX	3.4E+00	7.8E-07	3.0E-03	2.6E-04	
			Pathway Total:	1.1E-02	57%
Dermal Contact with Surface Soil					
Arsenic	1.1E+01	2.9E-07	2.9E-04	1.0E-03	
Barium	1.3E+02	3.5E-06	7.0E-03	5.0E-04	
Lead	3.2E+01	NA	NA	NA	
1,3,5-Tritrobenzene	4.9E-01	1.3E-07	2.5E-05	5.2E-03	
HMX	2.2E+00	5.8E-07	1.5E-02	3.9E-05	
RDX	3.4E+00	9.0E-07	3.0E-03	3.0E-04	
			Pathway Total:	7.0E-03	35%
Inhalation of Particulates					
Arsenic	5.8E-07	NA	NA	NA	
Barium	7.0E-06	2.3E-07	1.4E-04	1.6E-03	
Lead	1.7E-06	NA	NA	NA	
1,3,5-Trinitrobenzene	2.6E-08	NA	NA	NA	
HMX	1.2E-07	NA	NA	NA	
RDX	1.8E-07	NA	NA	NA	
			Pathway Total:	1.6E-03	8%
			Total RME HI:	2.0E-02	100%

[a]Units for the inhalation pathway are mg/m^3.

[b]See Appendix L for sources and methodology on estimating a daily intake value.

[c]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-88. Summary of Potential Systemic Effects for the Current Off-Site Adult Resident for SWMU 40 as a Whole

Chemical	Exposure Point Concentration (mg/m^3)	Daily Noncarcinogenic Intake[(a)] (mg/kg-day)	Chronic RfD[(b)] (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Inhalation of Particulates					
Arsenic	3.2E-07	NA[(d)]	NA	NA	
Barium	3.9E-06	1.3E-07	1.4E-04	9.3E-04	
Lead	9.2E-07	NA	NA	NA	
1,3,5-Trinitrobenzene	1.4E-08	NA	NA	NA	
HMX	6.4E-08	NA	NA	NA	
RDX	9.8E-08	NA	NA	NA	
			Total CTE HI:	9.3E-04	100%
Reasonable Maximum Exposure (RME) Scenario					
Inhalation of Particulates					
Arsenic	3.2E-07	NA	NA	NA	
Barium	3.9E-06	1.9E-07	1.4E-04	1.3E-03	
Lead	9.2E-07	NA	NA	NA	
1,3,5-Trinitrobenzene	1.4E-08	NA	NA	NA	
HMX	6.4E-08	NA	NA	NA	
RDX	9.8E-08	NA	NA	NA	
			Total RME HI:	1.3E-03	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.

[b]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-89. Summary of Potential Systemic Effects for the Current Off-Site Child Resident for SWMU 40 as a Whole

Chemical	Exposure Point Concentration (mg/m^3)	Daily Noncarcinogenic Intake(b) (mg/kg-day)	Chronic RfD(c) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Inhalation of Particulates					
Arsenic	3.2E-07	NA[(d)]	NA	NA	
Barium	3.9E-06	6.8E-07	1.4E-04	4.7E-03	
Lead	9.2E-07	NA	NA	NA	
1,3,5-Trinitrobenzene	1.4E-08	NA	NA	NA	
HMX	6.4E-08	NA	NA	NA	
RDX	9.8E-08	NA	NA	NA	
			Total CTE HI:	4.7E-03	100%
Reasonable Maximum Exposure (RME) Scenario					
Inhalation of Particulates					
Arsenic	3.2E-07	NA	NA	NA	
Barium	3.9E-06	4.9E-07	1.4E-04	3.4E-03	
Lead	9.2E-07	NA	NA	NA	
1,3,5-Trinitrobenzene	1.4E-08	NA	NA	NA	
HMX	6.4E-08	NA	NA	NA	
RDX	9.8E-08	NA	NA	NA	
			Total RME HI:	3.4E-03	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.

[b]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-90. Summary of Systemic Risk Results for the Current Adult Beef Consumer for Grazing Allotment 3 (SWMU 40)

Chemical	Exposure Point Concentration (mg/kg)	Daily Noncarcinogenic Intake(a) (mg/kg-day)	Chronic RfD(b) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Beef					
Arsenic	1.4E-04	3.5E-08	3.0E-04	1.2E-04	
Barium	2.5E-04	6.2E-08	7.0E-02	8.8E-07	
Lead	2.2E-05	NA[d]	NA	NA	
1,3,5-Trinitrobenzene	3.2E-07	7.8E-11	5.0E-05	1.6E-06	
HMX	4.7E-07	1.1E-10	5.0E-02	2.3E-09	
RDX	5.6E-07	1.4E-10	3.0E-03	4.6E-08	
			Total CTE HI:	1.2E-04	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Beef					
Arsenic	1.4E-04	1.4E-07	3.0E-04	4.7E-04	
Barium	2.5E-04	2.5E-07	7.0E-02	3.6E-06	
Lead	2.2E-05	NA	NA	NA	
1,3,5-Trinitrobenzene	3.2E-07	3.2E-10	5.0E-05	6.4E-06	
HMX	4.7E-07	4.7E-10	5.0E-02	9.4E-09	
RDX	5.6E-07	5.6E-10	3.0E-03	1.9E-07	
			Total RME HI:	4.8E-04	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.

[b]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-91. Summary of Systemic Risk Results for the Current Child Beef Consumer for Grazing Allotment 3 (SWMU 40)

Chemical	Exposure Point Concentration (mg/kg)	Daily Noncarcinogenic Intake(a) (mg/kg-day)	Chronic RfD(b) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Beef					
Arsenic	1.4E-04	7.7E-08	3.0E-04	2.6E-04	
Barium	2.5E-04	1.4E-07	7.0E-02	2.0E-06	
Lead	2.2E-05	NA(d)	NA	NA	
1,3,5-Trinitrobenzene	3.2E-07	1.7E-10	5.0E-05	3.5E-06	
HMX	4.7E-07	2.5E-10	5.0E-02	5.1E-09	
RDX	5.6E-07	3.0E-10	3.0E-03	1.0E-07	
			Total CTE HI:	2.6E-04	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Beef					
Arsenic	1.4E-04	2.2E-07	3.0E-04	7.3E-04	
Barium	2.5E-04	3.9E-07	7.0E-02	5.6E-06	
Lead	2.2E-05	NA	NA	NA	
1,3,5-Trinitrobenzene	3.2E-07	4.9E-10	5.0E-05	9.9E-06	
HMX	4.7E-07	7.2E-10	5.0E-02	1.4E-08	
RDX	5.6E-07	8.6E-10	3.0E-03	2.9E-07	
			Total RME HI:	7.4E-04	100%

[a]See Appendix L for sources and methodology on estimating a daily intake value.

[b]See Appendix M for sources and methodology of toxicity values.

[d]NA denotes not applicable. These COPC were not quantitatively included because toxicity information is not available for this pathway at this time.

Table 6-92. Summary of Potential Systemic Effects for the Ingestion of Groundwater Pathway for the Future On-Site Adult Resident for SWMU 40

Chemical	Exposure Point Concentration (mg/L)	Daily Noncarcinogenic Intake(a) (mg/kg-day)	Chronic RfD(b) (mg/kg-day)	Hazard Index (HI)	% Pathway Contribution
Central Tendency Exposure (CTE) Scenario					
Ingestion of Groundwater					
HMX	8.4E-01	9.7E-03	5.0E-02	1.9E-01	
RDX	4.1E+00	4.8E-02	3.0E-03	1.6E+01	
2,4-Dinitrotoluene	2.5E-01	2.9E-03	2.0E-03	1.4E+00	
Tetryl	2.9E-01	3.3E-03	1.0E-02	3.3E-01	
			Total CTE HI:	1.8E+01	100%
Reasonable Maximum Exposure (RME) Scenario					
Ingestion of Groundwater					
HMX	8.4E-01	1.8E-02	5.0E-02	3.5E-01	
RDX	4.1E+00	8.6E-02	3.0E-03	2.9E+01	
2,4-Dinitrotoluene	2.5E-01	5.2E-03	2.0E-03	2.6E+00	
Tetryl	2.9E-01	6.0E-03	1.0E-02	6.0E-01	
			Total RME HI:	3.2E+01	100%

[a] See Appendix L for sources and methodology on estimating a daily intake value.
[b] See Appendix M for sources and methodology of toxicity values.

Current/Future On-site Laborers. The cumulative ILCR for all pathways is 1.7E-06 and 2.3E-09 for the RME and CTE scenarios, respectively. As summarized in Table 6-61, the driving pathway is ingestion of surface soil which contributes greater than 84 percent of the total estimated risk.

Total ILCR for incidental ingestion of surface soil by laborers at SWMU 40 is 1.4E-06 and 1.8E-09 for the RME and CTE scenarios, respectively. Dermal contact with surface soil and inhalation of particulates by laborers does not present an individual risk above the lower bound of the target risk range. The estimated ILCRs for these pathways range from 1.7E-07 to 9.2E-11. Arsenic is the sole contributor to the estimated risks, contributing greater than 98 percent of the risk for each pathway evaluated.

Future On-site Adult Resident. The cumulative ILCR for all pathways is 5.4E-05 and 3.8E-06 for the RME and CTE scenarios, respectively. As summarized in Table 6-62, the driving pathway is ingestion of produce, which contributes greater than 92 percent of the estimated risk.

Incremental lifetime cancer risk attributed to ingestion of produce, such as homegrown vegetables by adults, results in an estimated ILCR of 5.0E-05 and 3.7E-06 using RME and CTE parameters, respectively. Ingestion of surface soil by adults during yard work, gardening, etc., results in an estimated ILCR of 4.0E-06 using RME conditions and 1.7E-07 using the CTE conditions. The ILCRs for the remaining pathways evaluated—dermal contact with surface soil and inhalation of particulates—are below the target risk range for both the RME and CTE scenarios, and range from 4.7E-07 to 8.5E-09. Arsenic is the sole contributor to this risk estimate.

Future On-site Child Resident. The cumulative ILCR for all pathways is 4.1E-05 and 7.1E-06 for the RME and CTE scenarios, respectively. As summarized in Table 6-63, the driving pathway is ingestion of produce, which contributes greater than 78 percent of the estimated risk.

Incremental lifetime cancer risk attributed to ingestion of produce, such as homegrown vegetables by children, results in an estimated ILCR of 3.3E-05 and 6.2E-06 using RME and CTE parameters, respectively. Ingestion of surface soil by children during yard work, playing, etc., results in an estimated ILCR of 8.4E-06 using RME conditions and 7.6E-07 using the CTE conditions. The ILCRs for the remaining pathways evaluated—dermal contact with surface soil and inhalation of particulates—are below the target risk range for both the RME and CTE scenarios, and range from 2.0E-07 to 1.4E-08. Arsenic is the sole contributor to this risk estimate.

Hot Spot in Vicinity of Test Pit ARP-94-48. The general process used to select the COPCs associated with the Hot Spot in Vicinity of Test Pit ARP-94-48 area of concern is described in Section 3.1.1.2. COPC selection for SWMU 40 is described in Section 6.2.4.2. For current and future land use scenarios, arsenic, barium, lead, 1,3,5-trinitrobenzene, HMX, and RDX were identified as COPCs. Arsenic, a known human carcinogen, and RDX, a possible human

carcinogen, are the only COPCs that contribute to the carcinogenic risk. Tables 6-55 and 6-56 list the COPCs and their associated media.

Current/Future On-site Laborers. The cumulative ILCR for all pathways is 5.8E-05 and 5.1E-08 for the RME and CTE scenarios, respectively. As summarized in Table 6-64, the driving pathway is dermal contact with surface soil, 54 percent, for the RME scenario and ingestion of surface soil, 66 percent, for the CTE scenario.

For the dermal contact with surface soil pathway, the total ILCR is 3.1E-05 and 1.7E-08 for the RME and CTE scenarios, respectively. Total ILCR for ingestion of surface soil by laborers at SWMU 40 is 2.7E-05 and 3.3E-08 for the RME and CTE scenarios, respectively. Inhalation of particulates by laborers does not present an individual risk above the lower bound of the target risk range. RDX is the major contributor to the estimated risks.

Future On-site Adult Resident. The cumulative ILCR for all pathways is 2.0E+01 and 1.5E+00 for the RME and CTE scenarios, respectively. As summarized in Table 6-65, the driving pathway is ingestion of produce, which contributes greater than 99 percent of the estimated risk.

Incremental lifetime cancer risk attributed to ingestion of produce, such as homegrown vegetables by adults, results in an estimated ILCR of 2.0E+01 and 1.5E+00 using RME and CTE parameters, respectively. For the dermal contact with surface soil pathway, the total ILCR is 8.5E-05 and 1.5E-06 for the RME and CTE scenarios, respectively. Ingestion of surface soil by adults during yard work, gardening, etc., results in an estimated ILCR of 7.3E-05 using RME conditions and 3.1E-06 using the CTE conditions. Inhalation of particulates by laborers does not present an individual risk above the lower bound of the target risk range. RDX is the major contributor to the estimated risks.

Future On-site Child Resident. The cumulative ILCR for all pathways is 1.3E+01 and 2.4E+00 for the RME and CTE scenarios, respectively. As summarized in Table 6-66, the driving pathway is ingestion of produce, which contributes greater than 99 percent of the estimated risk.

Incremental lifetime cancer risk attributed to ingestion of produce, such as homegrown vegetables by children, results in an estimated ILCR of 1.3E+01 and 2.4E+00 using RME and CTE parameters, respectively. For the dermal contact with surface soil pathway, the total ILCR is 3.6E-05 and 2.6E-06 for the RME and CTE scenarios, respectively. Ingestion of surface soil by children during yard work, gardening, etc., results in an estimated ILCR of 1.6E-04 using RME conditions and 1.4E-05 using the CTE conditions. Inhalation of particulates by laborers does not present an individual risk above the lower bound of the target risk range. RDX is the major contributor to the estimated risks.

Remainder of SWMU 40 (outside areas of concern). The general process used to select the COPCs associated with the remainder of SMWU 40 is described in Section 3.1.1.2. COPC selection for SWMU 40 is described in Section 6.2.4.2. For current and future land use

scenarios, arsenic, barium, lead, 1,3,5-trinitrobenzene, HMX, and RDX were identified as COPCs. Arsenic, a known human carcinogen, is the only COPC that contributes to the carcinogenic risk. Tables 6-57 and 6-58 list the COPCs and their associated media.

Current/Future On-site Laborers. The cumulative ILCR for all pathways is 1.6E-06 and 2.1E-09 for the RME and CTE scenarios, respectively. As summarized in Table 6-67, the driving pathway is ingestion of surface soil, which contributes greater than 84 percent of the total estimated risk.

Total ILCR for incidental ingestion of surface soil by laborers at SWMU 40 is 1.3E-06 and 1.6E-09 for the RME and CTE scenarios, respectively. Dermal contact with surface soil and inhalation of particulates by laborers do not present an individual risk above the lower bound of the target risk range. The estimated ILCRs for these pathways range from 1.5E-07 to 8.3E-11. Arsenic is the sole contributor to the estimated risks.

Future On-site Adult Resident. The cumulative ILCR for all pathways is 4.8E-05 and 3.4E-06 for the RME and CTE scenarios, respectively. As summarized in Table 6-68, the driving pathway is ingestion of produce, which contributes greater than 92 percent of the estimated risk.

Incremental lifetime cancer risk attributed to ingestion of produce, such as homegrown vegetables by adults, results in an estimated ILCR of 4.4E-05 and 3.2E-06 using RME and CTE parameters, respectively. Ingestion of surface soil by adults during yard work, gardening, etc., results in an estimated ILCR of 3.6E-06 using RME conditions and 1.5E-07 using the CTE conditions. The ILCRs for the remaining pathways evaluated—dermal contact with surface soil and inhalation of particulates—are below the target risk range for both the RME and CTE scenarios, and range from 4.2E-07 to 7.6E-09. Arsenic is the sole contributor to this risk estimate.

Future On-site Child Resident. The cumulative ILCR for all pathways is 3.7E-05 and 6.3E-06 for the RME and CTE scenarios, respectively. As summarized in Table 6-69, the driving pathway is ingestion of produce, which contributes greater than 78 percent of the estimated risk.

Incremental lifetime cancer risk attributed to ingestion of produce, such as homegrown vegetables by children, results in an estimated ILCR of 2.9E-05 and 5.4E-06 using RME and CTE parameters, respectively. Ingestion of surface soil by children during yard work, playing, etc., results in an estimated ILCR of 7.6E-06 using RME conditions and 6.8E-07 using the CTE conditions. The ILCRs for the remaining pathways evaluated—dermal contact with surface soil and inhalation of particulates—are below the target risk range for both the RME and CTE scenarios, and range from 1.8E-07 to 1.3E-08. Arsenic is the sole contributor to this risk estimate.

Future Construction Worker. The cumulative ILCR for all pathways is 1.86 and 1.3-07 for the RME and CTE scenarios, respectively. As summarized in Table 6-70, the driving pathway

is ingestion of subsurface soil, which contributes greater than 65 percent of the total estimated risk.

Total ILCR for incidental ingestion of subsurface soil by construction workers at SWMU 40 is 1.2E-06 and 8.3E-08 for the RME and CTE scenarios, respectively. Dermal contact with subsurface soil and inhalation of particulates by workers do not present an individual risk above the lower bound of the target risk range. The estimated ILCRs for these pathways range from 5.9E-07 to 3.0E-10. Arsenic is the only contributor to the estimated risks.

SWMU 40 as a Whole. The general process used to select the COPCs associated with SMWU 40 is described in Section 3.1.1.2. COPC selection for SWMU 40 is described in Section 6.2.4.2. For current and future land use scenarios, arsenic, barium, lead, 1,3,5-trinitrobenzene, HMX, and RDX were identified as COPCs. For the soil and air pathways, arsenic, a known human carcinogen, and RDX, a possible human carcinogen, are the only COPCs that contribute to the carcinogenic risk. For the groundwater pathway, HMX, RDX, 2,4-dinitrotoluene, and tetryl are identified as COPCs of which only RDX and 2,4-dinitrotoluene, a probable human carcinogen, contribute to the estimated risk. Tables 6-59 and 6-60 list the COPCs and their associated media.

Current/Future On-site Laborers. The cumulative ILCR for all pathways is 1.6E-06 and 2.1E-09 for the RME and CTE scenarios, respectively. As summarized in Table 6-71, the driving pathway is ingestion of surface soil, which contributes greater than 82 percent of the total estimated risk.

Total ILCR for incidental ingestion of surface soil by laborers at SWMU 40 is 1.3E-06 and 1.6E-09 for the RME and CTE scenarios, respectively. Dermal contact with surface soil and inhalation of particulates by laborers do not present an individual risk above the lower bound of the target risk range. The estimated ILCRs for these pathways range from 1.8E-07 to 9.8E-11. Arsenic is the major contributor to the estimated risks.

Current Off-site Adult Resident. The ILCR for inhalation of particulates by the current off-site adult resident is 9.2E-08 and 1.7E-08 under the RME and CTE scenarios, respectively (see Table 6-72). Arsenic is the only contributor to the estimated risk.

Current Off-site Child Resident. The ILCR for inhalation of particulates by the current off-site child resident is 1.4E-07 and 8.9E-08 under the RME and CTE scenarios, respectively (see Table 6-73). Arsenic is the only contributor to the estimated risk.

Current Adult Beef Consumer. The ILCR for ingestion of beef associated with the SWMU 40 grazing allotment by the adult residents in the surrounding communities is 8.5E-08 and 5.6E-09 under the RME and CTE scenarios, respectively (see Table 6-74). Arsenic is the main contributor to the estimated risk.

Current Child Beef Consumer. The ILCR for ingestion of beef associated with the SWMU 40 grazing allotment by the child residents in the surrounding communities is 7.8E-08 and

1.2E-08 under the RME and CTE scenarios, respectively (see Table 6-75). Arsenic is the main contributor to the estimated risk.

<u>SWMU 40 Groundwater Pathway</u>

Future On-site Adult Resident. Evaluated separately from the soil and air pathways, ingestion of groundwater by potential on-site adult residents results in a ILCR of 5.2E-03 to 7.7E-04 for the RME and CTE scenario (See Table 6-76). However, it should be noted that environmental degradation of the COPCs evaluated was not taken into account when estimating the EPC. It is also estimated that these potential COPCs will not reach the water table for at least 2 to 3 decades from this point in time. For these reasons, the RME and CTE ILCRs for the ingestion of groundwater pathway are very likely to be an overestimate of risk.

6.2.4.5.2 *Characterization of Potential Systemic Effects*

<u>Hot Spot Near Old Furnace Building Area of Concern.</u> The general process used to select the COPCs associated with the Hot Spot Near Old Furnace Building area of concern is described in Section 3.1.1.2. COPC selection for SWMU 40 is described in Section 6.2.4.2. For current and future land use scenarios, arsenic, barium, lead, 1,3,5-trinitrobenzene, HMX and RDX were identified as COPCs. Arsenic and barium are the only COPCs evaluated for potential systemic effects. Tables 6-53 and 6-54 list the COPCs and their associated media.

Current/Future On-site Laborers. As summarized in Table 6-77, the summed HI is 1.2 E-02 and 1.4E-04 under the RME and CTE scenarios, respectively. The driving pathway is ingestion of surface soil, which contributes greater than 73 percent of the total HI. The major contributor to the risk estimates is arsenic.

Future On-site Adult Resident. As summarized in Table 6-78, the summed HI for all pathways does not exceed unity (one) and ranges from 3.0E-01 to 8.3E-02 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of produce, leafy vegetables, tuber, and fruits, which contributes greater than 92 percent of the total HI. The major contributor to the risk estimates is arsenic.

Future On-site Child Resident. As summarized in Table 6-79, the summed HI for all pathways does not exceed unity (one) and ranges from 3.9E-01 to 1.5E-01 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of produce, leafy vegetables, tuber, and fruits, which contributes greater than 78 percent of the total HI. The major contributor to the risk estimates is arsenic.

<u>Hot Spot in Vicinity of Test Pit ARP-94-48 Area of Concern.</u> The general process used to select the COPCs associated with the Hot Spot in Vicinity of Test Pit ARP-94-48 area of concern is described in Section 3.1.1.2. COPC selection for SWMU 40 is described in Section 6.2.4.2. For current and future land use scenarios, arsenic, barium, lead, 1,3,5-trinitrobenzene, HMX, and RDX were identified as COPCs. Systemic effects are evaluated for all COPCs. Tables 6-55 and 6-56 list the COPCs and their associated media.

Current/Future On-site Laborers. As summarized in Table 6-80, the summed HI is 5.4E-01 and 4.0E-03 under the RME and CTE scenarios, respectively. The driving pathway is dermal contact with surface soil, 53 percent, for the RME scenario and ingestion of surface soil, 66 percent, for the CTE scenario. The major contributor to the risk estimates is RDX.

Future On-site Adult Resident. As summarized in Table 6-81, the summed HI for all pathways is 1.5E+05 and 4.3E+04 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of produce, which contributes greater than 99 percent of the total HI.

The total HI for ingestion of produce by adult residents is 1.5E+05 and 4.3E+04 for the RME and CTE scenarios. The HIs for the remaining pathways evaluated are below unity (one) and range from 6.5E-01 to 1.7E-03. The major contributor to the risk estimates is RDX.

Future On-site Child Resident. As summarized in Table 6-82, the summed HI for all pathways is 1.6E+05 and 7.0E+04 for the the RME and CTE scenarios, respectively. The driving pathway is ingestion of produce, which contributes greater than 99 percent of the total HI.

The total HI for ingestion of produce by child residents is 1.6E+05 and 7.0E+04 for the RME and CTE scenarios, respectively. For the ingestion of surface soil pathway, the total HI is 2.1E+00 and 4.2E-01 for the RME and CTE scenarios. The HIs for the remaining pathways evaluated, dermal contact with surface soil and inhalation of particulates, are below unity and range from 4.6E-01 to 8.5E-03. The major contributor to the risk estimates is RDX.

<u>**Remainder of SWMU 40 (outside areas of concern).**</u> The general process used to select the COPCs associated with the remainder of SWMU 40 outside the areas of concern is described in Section 3.1.1.2. COPC selection for SWMU 40 is described in Section 6.2.4.2. For current and future land use scenarios, arsenic, barium, lead, 1,3,5-trinitrobenzene, HMX, and RDX were identified as COPCs. Systemic effects are only evaluated for arsenic, barium, 1,3,5-trinitrobenzene. Tables 6-57 and 6-58 list the COPCs and their associated media.

Current/Future On-site Laborers. As summarized in Table 6-83, the summed HI is 1.4E-02 and 1.5E-04 under the RME and CTE scenarios, respectively. The driving pathway is ingestion of surface soil, which contributes greater than 77 percent. The major contributor to the risk estimates is arsenic.

Future On-site Adult Resident. As summarized in Table 6-84, the summed HI for all pathways ~~does not~~ exceeds unity (one) and ranges from 2.3E+02 to 6.5E+01 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of produce, leafy vegetables, tuber, and fruits, which contributes greater than 99 percent of the total HI. The major contributor to the risk estimates is arsenic.

Future On-site Child Resident. As summarized in Table 6-85, the summed HI for all pathways ~~does not~~ exceeds unity (one) and ranges from 2.5E+02 to 1.1E+02 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of produce, leafy vegetables,

tuber, and fruits, which contributes greater than 99 percent of the total HI. The major contributor to the risk estimates is arsenic.

Future Construction Worker. As summarized in Table 6-86, the summed HI is 6.6E-02 and 1.4E-02 for the RME and CTE scenarios, respectively. The driving pathway is ingestion of subsurface soil, which contributes nearly 100 percent. The sole contributor to the risk estimates is arsenic.

SWMU 40 as a Whole. The general process used to select the COPCs associated with SWMU 40 as a whole is described in Section 3.1.1.2. COPC selection for SWMU 40 is described in Section 6.2.4.2. For current and future land use scenarios, arsenic, barium, lead, 1,3,5-trinitrobenzene, HMX, and RDX were identified as COPCs. Systemic effects are evaluated for all COPC associated with the soil, air, and beef pathways with the exception of lead. For the groundwater pathway, HMX, RDX, 2,4-dinitrotoluene, and tetryl are identified as COPCs of which all are evaluated for systemic effects. Tables 6-59 and 6-60 list the COPCs and their associated media.

Current/Future On-site Laborers. As summarized in Table 6-87, the summed HI is 2.0E-02 and 1.6E-04 under the RME and CTE scenarios, respectively. The driving pathway is ingestion of surface soil, which contributes greater than 57 percent. The major contributor to the risk estimates is arsenic.

Current Off-site Adult Resident. As summarized in Table 6-88, the HI for the inhalation of particulates pathway does not exceed unity (one). The total HIs for the inhalation pathway ranges from 1.3E-03 to 9.4E-04 for the RME and CTE scenarios, respectively. The sole contributor to the risk estimates is barium.

Current Off-site Child Resident. As summarized in Table 6-89, the HI for the inhalation of particulates pathway does not exceed unity (one). The total HIs for the inhalation pathway ranges from 3.4E-03 to 4.7E-03 for the RME and CTE scenarios, respectively. The sole contributor to the risk estimates is barium.

Current Adult Beef Consumer. As summarized in Table 6-90, the total HI is 4.8E-04 and 1.2E-04. The major contributor to the HI is aresenic.

Current Child Beef Consumer. As summarized in Table 6-91, the total HI is 7.4E-04 and 2.6E-04. The major contributor to the HI is arsenic.

Groundwater Pathway

Future On-site Adult Resident. Evaluated separately from the soil and air pathways, ingestion of groundwater by potential on-site adult residents results in a summed HI of 3.2E+01 and 1.8E+01 for the RME and CTE scenario (see Table 6-92). However, it should be noted that environmental degradation of the COPC evaluated was not taken into account when estimating the EPC. It is also estimated that these potential COPCs will not reach the water table for at

least 2 to 3 decades from this point in time. Additionally, the HI estimation assumes additivity of effects for all COPCs evaluated. As described in Appendix M, the critical effects for the COPCs evaluated are as follows: HMX—hepatic lesions; RDX—inflammation of the prostate; 2,4-dinitrotoluene—neuortoxicity, Heinz bodies, and biliary tract hyperplasia; and tetryl—liver, kidney, and spleen effects. For these reasons, the RME and CTE HIs for the ingestion of groundwater pathway are very likely to be an overestimate of risk.

6.2.4.5.3 *Characterization of Hazards Associated with Exposures to Lead*

Current Off-site Child Residents. The USEPA has developed the IEUBK model to evaluate lead exposure in children. The model estimates blood lead levels resulting from all applicable routes of exposure. The agency has set a target blood lead level of 10 μg Pb/dL blood. The IEUBK model was run for potential off-site residential exposures to resuspended lead-containing particulate. All defaults in the model were maintained with the exception of the input air concentration and the parameters—time spent outdoors, 3 hours/day, and lung absorption rate, 50 percent (See Appendix L). The air concentration input value is the boundary line concentration based on an average lead concentration resulting from the air dispersion modeling (Appendix N). Predicted mean blood lead levels ranged from 4.5 μg Pb/dL blood for children aged 1 to 2 years down to 2.7 μg Pb/dL blood for children aged 6 to 7 years. Mean blood lead level for the age span 0 to 7 years is 3.7 μg Pb/dL blood, which is below the USEPA target blood lead level of 10 μg Pb/dL blood.

Future On-site Child Residents. The IEUBK model was run for potential future on-site residential exposures to lead in soil, produce, air, and drinking water. All defaults in the model were maintained except the input air, soil, and produce concentrations and the parameters—time spent outdoors, 3 hours/day, and lung absorption rate, 50 percent (see Appendix L). The input air value is the boundary line concentration based on an average lead concentration resulting from the air dispersion modeling (Appendix N). Lead concentrations in soil and produce are based on an average EPC for lead. Predicted blood lead levels for this hot spot from the IEUBK model ranged from 5.8 μg Pb/dl blood in the 1-to-2-year age group to 3.4 μg Pb/dl blood in the 6-to-7-year age group. The mean blood lead level for the 6.5 year span of the model was 4.76 μg Pb/dL blood. This, in effect, yields an HQ of approximately 0.5. Soil and dust uptake is the driving pathway, contributing greater that 5 percent of the total blood lead level.

Occupational exposure to lead is not evaluated because the future on-site child resident and current off-site child resident scenarios lead to acceptable blood lead levels and, therefore, provide a sufficient upper bound for on-site risk to encompass occasional use by military or civilian personnel in the course of their duties.

6.2.4.6 *Risk Assessment Summary and Conclusions*

An RA was conducted for the AED Test Range (SWMU 40) based on Phase I and Phase II RI data. Several current- and future-use scenarios were quantitatively evaluated:

- On-site laborer/security worker
- Off-site resident (inhalation only)
- On-site residents (redevelopment)
- Construction worker (during redevelopment)
- Consumer of beef grazed on the grazing allotment containing SWMU 40

A summary of RME risk results for SWMU 40 is shown in Table 6-93 and of CTE risk results in Table 6-94.

For the current/future on-site laborer/security worker, all scenarios were found to fall within or below the target risk range of 10^{-4} to 10^{-6} for the ILCR and unity (one) for the total HI. For the RME scenario, an ILCR on the order of 10^{-5} was estimated from exposure to surface soil from the Hot Spot in Vicinity of Test Pit ARP-94-48 area of concern. These risk results are conservative because it was assumed that the on-site laborer/security worker would be working at the same area of concern or SWMU for the entire length of service. However, based on the job description for this receptor, continued exposure to a single location is very unlikely.

ILCRs for both adult and child off-site residents were well below the lower limits of the target risk range of 10^{-6} for the ILCR and unity (one) for the HI. The same is also true for the current adult and child beef consumer.

Risk results for both future on-site adult and child residents exceeded the target risk range of 10^{-4} to 10^{-6} for carcinogenic risk for one of the areas of concern—Hot Spot in Vicinity of Test Pit ARP-94-48. The total ILCRs for all pathways for this area of concern range from 2.0E+01 to 1.5E+00 and 1.3E+01 to 2.4E+00 for the adult and child RME and CTE scenarios, respectively. Total ILCRs for the remaining areas evaluated are within the target risk range. For the total HI, two of the areas of concern exceed unity (one) for the target HI—Hot Spot in Vicinity of Test Rt ARP-94-48 and Remainder of Site. For the adult and child RME and CTE scenarios, the HI ranges from 1.5E+05 to 6.5E+01 and 1.6E+05 to 1.1E+02, respectively. The HIs for the remaining area evaluated is below unity for both the potential adult and child on-site resident. The ingestion of produce pathway is the major contributor to the risk results.

Food-chain pathways (i.e. home gardening) are significant contributors to total risks. According to Lee Sherry, a home economist with the Utah State University Agricultural Extension Service in Tooele, saline content in area soils generally require home gardeners and landscapers to replace or augment the existing soil with new topsoil. The above observation is confirmed by soil testing results from the Utah State University Soil Testing Laboratory (Appendix G).

Due to a lack verified toxicity data for lead, potential systemic effects for that metal were quantitatively evaluated based on EPA's Integrated Exposure Uptake Biokinetic Model (USEPA 1994) for lead in children. The model estimates blood lead levels resulting from all applicable routes of exposure. The agency has set a target blood lead level of 10 μg Pb/dL blood. For the inhalation of particulates pathway for the current off-site child resident, a mean blood lead level of 3.7 μg Pb/dL for the age span 0 to 7 years was estimated, which is below the USEPA target blood lead level of 10 μg Pb/dL blood. Predicted mean blood lead levels

Table 6-93. Summary of RME Risk Results for SWMU 40

	Hot Spot Near Old Furnace Building			Hot Spot in Vicinity of Test Pit		Remainder of SWMU		SWMU as a Whole		
Scenario	HI	ILCR	Blood Lead Levels (μg Pb/dL Blood)	HI	ILCR	HI	ILCR	HI	ILCR	Blood Lead Levels (μg Pb/dL Blood)
Current Land Use										
On-site Laborer	1.2E-02	1.7E-06	---	5.4E-01	5.8E-05	1.4E-02	1.6E-06	2.0E-02	1.6E-06	---
Off-site Adult Resident	---[a]	---	---	---	---	---	---	1.3E-03	9.2E-08	---[b]
Off-site Child Resident	---	---	---	---	---	---	---	3.4E-03	1.4E-07	3.70
Adult Beef Consumer	---	---	---	---	---	---	---	4.8E-04	8.5E-08	---
Child Beef Consumer	---	---	---	---	---	---	---	7.4E-04	7.8E-08	---
Future Land Use										
On-site Adult Resident	3.0E-01	5.4E-05	---[b]	1.5E+05	2.0E+01	2.3E+02	4.8E-05	---	---	---
On-site Child Resident	3.9E-01	4.1E-05	4.80	1.6E+05	1.3E+01	2.5E+02	3.7E-05	---	---	---
Construction Worker	---	---	---	---	---	6.6E-02	1.6E-06	---	---	---

[a]Not evaluated.
[b]Per EPA Guidance, the IEUBK model is designed for the child receptor, who is the most sensitive receptor. Therefore, blood lead levels for the adult receptor were not quantified.

Table 6-94. Summary of CTE Risk Results for SWMU 40

	Hot Spot Near Old Furnace Building			Hot Spot in Vicinity of Test Pit		Remainder of SWMU		SWMU as a Whole		
Scenario	HI	ILCR	Blood Lead Levels (μg Pb/dL Blood)	HI	ILCR	HI	ILCR	HI	ILCR	Blood Lead Levels (μg Pb/dL Blood)
Current Land Use										
On-site Laborer	1.4E-04	2.3E-09	---	4.0E-03	5.1E-08	1.5E-04	2.1E-09	1.6E-04	2.1E-09	---
Off-site Adult Resident	---[a]	---	---	---	---	---	---	9.3E-04	1.7E-08	---[b]
Off-site Child Resident	---	---	---	---	---	---	---	4.7E-03	8.9E-08	3.70
Adult Beef Consumer	---	---	---	---	---	---	---	1.2E-04	5.6E-09	---
Child Beef Consumer	---	---	---	---	---	---	---	2.6E-04	1.2E-08	---
Future Land Use										
On-site Adult Resident	8.3E-02	3.8E-06	---[b]	4.3E+04	1.5E+00	6.5E+01	3.4E-06	---	---	---
On-site Child Resident	1.5E-01	7.1E-06	4.80	7.0E+04	2.4E+00	1.1E+02	2.1E-09	---	---	---
Construction Worker	---	---	---	---	---	1.4E-02	1.3E-07	---	---	---

[a]Not evaluated.
[b]Per EPA Guidance, the IEUBK model is designed for the child receptor, who is the most sensitive receptor. Therefore, blood lead levels for the adult receptor were not quantified.

for the hypothetical on-site child resident ranged from 5.8 μg Pb/dL blood for children aged 1 to 2 years down to 3.4 μg Pb/dL blood for children aged 6 to 7 years. Mean blood lead level for the age span 0 to 7 years is 4.76 μg Pb/dL blood, which is also below the USEPA target blood lead level of 10 μg Pb/dL blood. Occupational exposure to lead is not evaluated because it is assumed that the future on-site child resident and current off-site child resident scenarios provide a sufficient upper bound for on-site risk to encompass occasional use by military personnel for weapons testing.

ILCRs for the future construction worker were within or below the target risk range of 10^{-4} to 10^{-6} for carcinogenic risk and unity (one) for the HI.

When site-specific conditions are considered along with the conservative assumptions designed to offset assessment uncertainties, the risk estimates for the future residential scenario are, in point of fact, likely to be overestimates. Under the current BRAC, SWMU 40 is not included in the parcel for potential release for private redevelopment. The mission of SWMU 40 is assumed to continue into the indefinite future. Based on the above considerations, the risk assessment results indicate that there is no immediate and substantial danger to human health from the presence of low levels of hazardous chemicals at SWMU 40 with the exception of the Hot Spot in Vicinity of Test Pit ARP-94-48.

6.2.5 Conclusions and Recommendations

During the Summer of 1994, the AED Test Range (SWMU 40) Phase II field investigation was conducted to further characterize the nature and extent of contamination that had been detected during Phase I. To accomplish this, 60 test pits were excavated to a depth of 5 feet with soil samples collected at the 0.5-, 3-, and 5-foot depths. All of the soil samples were analyzed for metals and explosives. Additionally, geophysical and UXO survey results were used to assist with the characterization. Most of the test pits were located in areas of possible projectile impact and areas containing debris. Other pits were located around the SWMU perimeter to determine horizontal extent of contamination. Metal debris, UXO, and propellant were encountered during the investigation. Analytical results indicate that several metals are present at levels above the calculated background concentrations. These metals were carried forward to the human health risk assessment. There were also some explosives detected at SWMU 40 and a few traces of SVOCs.

Risk assessment results indicate that no immediate or substantial danger to human health under current or future land use scenarios exists as a result of the COPCs that were detected in the soils at the AED Test Range with the exception of the hot spot in the vicinity of Test Pit ARP-94-48, which had ILCR and HI risks and hazards exceeding USEPA risk-based criteria for future on-site residents. Ecological risk results for SWMU 40 are presented in the TEAD SWERA report (Rust E&I 1996).

Results of a grid survey of debris and UXO at SWMU 40 indicates that an explosive risk still exists. As a result, it is recommended that UXO clearance be provided prior to any work or

sampling at SWMU 40. Additionally, prior to granting any future land use activities, it is recommended that the entire SWMU be surveyed for UXO to a depth that is appropriate for the given future land use application. Because of the live round that was discovered in test pit ARP-94-44, this trench should be surveyed for UXO as part of the FS process. In addition to this UXO surveying, additional soil sampling for antimony and thallium may be necessary before releasing the land for future unrestricted residential use. This information will be carried forward through the FS and ROD process.

Based on the analytical data along with the results of the risk assessment, it is recommended that no further remedial investigation is necessary. Table 6-93 (RME) and 6-94 (CTE) provides a summary of all risks estimated for SWMU 40. The AED Test Range will be carried forward to the feasibility study as required by CERCLA to determine whether any remedies are required for this SWMU. At a minimum, cleanup of the hot spot in the vicinity of Test Pit ARP-94-48, additional UXO surveys, and further investigation of antimony and thallium in soil, as noted above, would be necessary to reduce risks to future residents to acceptable levels. It is important to note that conclusions from this report and the SWERA will be used during the FS process to derive final recommendations for SWMU 40.

7.0 CONCLUSIONS AND RECOMMENDATIONS

SWMU-specific conclusions and recommendations were provided in Sections 4.0, 5.0, and 6.0 for each of the SWMUs within OUs 4, 8, and 9, respectively. This section provides a summary of those conclusions and recommendations. The conclusions are based on the information gathered from previous investigations along with data collected during the Phase II RI. The recommendations are based on the results of assessments conducted to estimate the risk to human health. A site-wide ecological risk assessment was conducted by Rust E&I (1996) on a facility-wide basis to assess risks to the environment. The results of this study are summarized in a separate document, the *Final TEAD-N Site-Wide Ecological Risk Assessment* (Rust E&I 1996). The findings from the Phase II RI study and the site-wide ecological risk assessment will subsequently be used in the completion of the FS, where various remedial-action alternatives will be screened, analyzed, and recommended for each of the three OUs.

In general, Rust E&I has recommended that no further RI field investigation activities be conducted. For SWMUs where the vertical and horizontal extent of contamination has not been completely defined, the associated human health and environmental risks were assessed and found to be within or below the corresponding regulatory risk-based criteria. The following sections provide OU-specific conclusions and recommendations in a summary form on the basis of the findings presented in Sections 4.0, 5.0, and 6.0 of this report. Table 7-1 (see pages 7-8 through 7-12) also provides a summary of the Phase II RI results, conclusions, and recommendations.

7.1 OPERABLE UNIT 4—SWMUs 31, 32, AND 35

OU 4 consists of three sites located in the eastern part of TEAD-N: the Former Transformer Boxing Area (SWMU 31), the PCB Spill Site (SWMU 32), and the Wastewater Spreading Area (SWMU 35). SWMUs 31 and 32 and the extreme eastern portion of SWMU 35 are within the BRAC parcel. Sufficient data were collected during the Phase II RI to (1) characterize the potential contamination, (2) evaluate baseline risks to human receptors, and (3) conduct an FS. In addition, the *Final TEAD-N Site-Wide Ecological Risk Assessment* (Rust E&I 1996) evaluated potential risks to the flora and fauna at these three SWMUs. Therefore, from the above findings, no further RI field investigations appear to be warranted for these three SWMUs. As required by CERCLA, an FS will be completed for SWMUs 31, 32, and 35.

The initial concern at SWMUs 31 and 32 was the release of PCBs to the environment. No Phase I investigations were performed at these SWMUs. On the basis of further review of previous information, it was determined that additional sampling and analysis were required at SWMUs 31 and 32. Low concentrations of SVOCs were the only analytes detected at SWMU 31 during Phase II sampling activities. It is suspected that these may be associated with fluid leakage from vehicles. These vehicles have since been removed from TEAD-N. The only COPCs identified at SWMU 31 were total carcinogenic PAHs; human health risks associated with these COPCs were found to be within or below regulatory risk-based criteria for this SWMU. At SWMU 32, Phase II sampling results indicated that PCBs were not present in

surface or subsurface soils. A few SVOCs and metals above background concentrations were found. Arsenic, cadmium, and chromium were the COPCs retained for the quantitative human health risk assessment. Calculated risks to human health were below the USEPA criteria; therefore, no unacceptable human health risks were found to be associated with SWMU 32.

Following the Phase I investigation, the concern at SWMU 35 was elevated metals in the spreading area and the presence of pesticides as indicated in one sample at the eastern end of one of the ditches. The elevated metals were believed to be related to metal debris found at one test pit location in the wastewater spreading area. A follow-up survey using a metal detector revealed this debris to be contained within a small area and characterized as miscellaneous automotive parts. Phase II sampling at SWMU 35 found pesticides and metals above background concentrations in both surface and subsurface soils. Arsenic, delta-benzenehexachloride, alpha-chlordane, gamma-chlordane, endrin, heptachlor, and heptachlor epoxide were identified as COPCs. The quantitative human health risk assessment indicated that all scenarios, except a hypothetical future resident, fall within or below the USEPA target ranges for carcinogenic and chronic noncarcinogenic risks. Risk estimates for future residents are near the upper bound but can be considered acceptable under USEPA guidance. No analytes above the MCLs were detected in the groundwater sample collected from the water supply well (WW-1) located downgradient of SWMU 35. This SWMU will be evaluated for potential remedial action alternatives during the FS. If future land use changes from industrial to residential use, further evaluation of potential thallium contamination in soils will be required. This fact will be stated in the FS.

7.2 OPERABLE UNIT 8—SWMUs 6, 7, 13, 22, 23, AND 36

OU 8 is made up of six SWMUs generally located in the southwestern section of TEAD-N: the Old Burn Area (SWMU 6), the Chemical Range (SWMU 7), the Tire Disposal Area (SWMU 13), Building 1303 Washout Pond (SWMU 22), the Bomb and Shell Reconditioning Building (SWMU 23), and the Old Burn Staging Area (SWMU 36). Sufficient data were collected during the Phase II RI to characterize the potential contamination, to evaluate baseline risks to human receptors, and to conduct an FS. In addition, the *Final TEAD-N Site-Wide Ecological Risk Assessment* (Rust E&I 1996) evaluated potential risks for each of the OU 8 SWMUs. These results will also provide information required to conduct the FS for the six SWMUs in OU 8. Therefore, no further RI field investigations appear to be warranted.

SWMU 13 had no previous sampling conducted because of the relative long-term stability of tires in the environment. Phase I investigations consisted of a site walkover to identify potential waste sites from disposal of wastes other than tires. No sites were identified during Phase I. Subsequent to Phase I, the tires at SWMU 13 were removed and hauled off-site for reuse, leaving the floor of the former gravel pit exposed. During the Phase II investigation, test pits were excavated, and surface and subsurface soil samples were collected to investigate the possibility that other materials had been disposed of in the gravel pit. Small areas of surface staining were observed; low concentrations of SVOCs and VOCs were detected; and metals in concentrations above background were identified. However, after the evaluation and screening of the data against risk-based criteria, only chloromethane and diethyl phthalate were

retained as COPCs for the quantitative human health risk assessment. All current scenario risk estimates for SWMU 13 were well below regulatory risk-based criteria, and all future scenarios were either within or below the criteria.

Three areas where munitions were tested and debris from the testing was burned and buried—SWMUs 6, 7, and 36—were investigated. At SWMU 6, additional test pits were excavated during Phase II to further investigate the geophysical anomalies identified during the Phase I geophysical survey, and additional surface soil samples were collected to determine the extent of the low level of surface explosives contamination identified in Phase I. Additionally, surface and subsurface soil samples were collected and analyzed for dioxins/furans in order to evaluate potential contamination from years of open burning at SWMU 6. Buried metal debris was found in a number of test pits, and elevated metals were detected in the corresponding soil samples. One explosive, RDX, was detected in only one subsurface sample. Explosives identified in Phase I were not confirmed in the surface soil samples in the drainage gullies during Phase II. Dioxins and furans were detected in surface samples throughout the SWMU 6 area in low concentrations. These levels were similar to those found in samples away from the SWMU 6 boundary as background samples. Higher concentrations were found in subsurface samples from the burn zones of the former trenches. However, average concentrations were below the corresponding risk-based concentration. On the basis of low levels, corresponding levels in background samples, and comparison to risk-based levels, dioxins/furans were not retained as COPCs. Aluminum, antimony, arsenic, chromium, copper, iron, lead, thallium, zinc, and 1,3,5-trinitrobenzene were COPCs retained for the quantitative human health risk assessment after the evaluation and screening of the data. SWMU 6 was evaluated on a hot spot, area of concern, and site-wide basis. Estimated risks to human health for current scenarios are within or below USEPA criteria for SWMU 6. For the revetment area of SWMU 6, the future on-site resident (adult and child) had estimated carcinogenic risks within USEPA criteria but had noncarcinogenic hazard indices exceeding unity primarily due to ingestion of copper in produce raised at the SWMU. At the revetment area hot spot, risks to the construction worker exceeded criteria for exposure to lead. No other scenarios or areas within SWMU 6 had risk estimates exceeding USEPA criteria. Since all trenches were not fully evaluated, any future construction activities at SWMU 6 will require additional evaluation of identified trench areas. This fact will be reflected in the FS.

At SWMU 7, the Phase II investigation was conducted to further characterize the disposal area at the Firing Point, to investigate the area around an open trench located adjacent to an additional testing area northwest of the Firing Point, and to determine if contamination is present along the firing course as a result of the testing activities. Additional areas of buried metal debris were encountered during test pit excavations. Metals above background concentrations were detected in surface and subsurface soils, with the only significant concentrations in the soils in the immediate vicinity of the Bullet Stop. Scattered low concentrations of SVOCs were also detected. The COPCs retained for SWMU 7 were aluminum, arsenic, beryllium, manganese, and thallium. Estimated risks to human health under all of the evaluated scenarios for SWMU 7 are within or below USEPA criteria with the exception of noncarcinogenic risks to the current off-site child resident, future on-site residents, and the construction worker at the Northeast Test Area Trench and to the future child resident at the Bullet Stop. No other human health risks exceeding USEPA criteria were

associated with the COPCs identified at this SWMU. TEAD has submitted plans to conduct a voluntary removal action at the Northeast Test Area Trench to minimize or eliminate risks to human health and the environment.

At SWMU 36, the Phase II field investigation consisted of the collection of additional surface and subsurface soil samples to determine the vertical and horizontal extent of the elevated metals concentrations identified during Phase I in the former burn areas in the gravel pit. Metals at concentrations above background were detected in surface samples within the former gravel pit where evidence of burning activities were observed. After the evaluation and screening of the data, barium, copper, and lead were the COPCs retained for use in the quantitative risk assessment. A hot spot analysis was performed and human health risks associated with a hot spot area within the gravel pit were evaluated as well as the SWMU as a whole. Results for current scenarios indicate that there is no risk to human health that exceeds USEPA criteria. For the future scenarios, the future on-site resident (adult and child) had noncarcinogenic hazard indices exceeding unity primarily from the ingestion of copper in produce raised at SWMU 36. No other human health risks exceeding regulatory criteria appear to be associated with this SWMU.

SWMUs 22 and 23 are areas where munitions were disassembled or reconditioned and painted. At SWMU 22, Phase II surface and subsurface soil samples were collected to further investigate the nature and extent of elevated concentrations of metals and explosives that resulted from former washdown activities. Metals above background concentrations and explosives were found in both the surface and subsurface soils. The explosives were confined to the discharge ditch and ponding area of the SWMU. The elevated metals were primarily on the surface but present throughout the SWMU. Following the evaluation and screening of the analytical data, the explosives 1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, and RDX; and the metal chromium were retained for the quantitative human health risk assessment. The estimated risks under current scenarios are within USEPA criteria with the exception of noncarcinogenic hazard indices exceeding unity primarily due to ingestion of explosives in soil. For future land use scenarios, the noncarcinogenic hazard indices exceed unity for future on-site residents. These results all indicate that remedial action to mitigate potential risks will be required. Various alternatives will be considered as part of the FS currently being conducted. TEAD has submitted plans to conduct a voluntary removal action of explosive- and metals-contaminated soils at SWMU 22. Remediation levels will be negotiated with USEPA and UDEQ. These levels will be protective of human health and the environment and will be protective of the groundwater.

For SWMU 23, further investigation during Phase II was required to better define the extent of contamination resulting from wastewater discharges and to further define the horizontal spread of contamination along the perimeter of the paved area of this SWMU. Surface and subsurface soils were collected. Stained areas associated with the outfalls and discharge areas contained metals above background concentrations, SVOCs, cyanide (at low concentrations), and PCBs. After evaluation and screening of the data, cadmium, chromium, lead, anthracene, phenanthrene, pyrene, PCB 1248, total PCBs, and total carcinogenic PAHs were the COPCs retained for the quantitative human health risk assessment. Risks associated with these COPCs were evaluated on an individual area of concern and site-wide basis. Results of the baseline

human health risk assessment indicate that carinogenic risks for all areas and scenarios are within USEPA criteria except for the future on-site resident in the Building 1345 Outfall area of concern primarily from possible ingestion of produce grown in the area of concern. For noncarcinogenic risks, the Building 1345 Outfall area of concern had hazard indices exceeding unity for the future adult and child on-site residents primarily from ingestion of soils containing PCBs, dermal contact with cadmium in soils, and ingestion of cadmium in produce. It was determined that possible consideration should be given to conducting a "hot spot" removal of the stained soils in the outfall and discharge area and the stained areas adjacent to the asphalt at SWMU 23. An area that had an elevated PID reading was not evaluated during the Phase II RI. Additional evaluation will be required during the FS process for potential VOC contamination at this SWMU.

7.3 OPERABLE UNIT 9—SWMUs 8 AND 40

OU 9 consists of two test ranges in the northwestern portion of TEAD-N: the Small Arms Firing Range (SWMU 8) and the AED Test Range (SWMU 40). Sufficient data were collected during the Phase II RI to characterize the potential contamination, to evaluate baseline risks to human receptors, to evaluate risks to ecological receptors, and to conduct an FS. Therefore, no further RI field investigations appear to be warranted for these two SWMUs.

Phase II soil sampling at SWMU 8 was conducted to further evaluate the nature and extent of elevated metals concentrations detected in the Phase I composite samples. Metals at concentrations exceeding background were detected throughout the site, but the highest concentrations are located within the bullet stop areas. Additional characterization of the area beyond the bullet stops in November 1995 indicates that contamination beyond the bullet stops is minimal compared to other portions of the SWMU. Aluminum, antimony, arsenic, chromium, copper and lead were identified as the COPCs for the quantitative human health risk assessment. For the purpose of the risk assessment, SWMU 8 was evaluated on an area-of-concern basis as well as a site-wide basis. No current human health risks exceeding USEPA criteria were identified for any area within SWMU 8. The only identified risks exceeding regulatory goals were for the future on-site residents in the bullet stop area, where noncarcinogenic hazards exceeded unity primarily due to ingestion of produce. In addition, exposure to lead was evaluated separately for each scenario and the future child on-site resident was shown to be at risk from exposure to lead. Cleanup options will be evaluated during the FS, including possible removal actions at the bullet stop area of SWMU 8.

At SWMU 40, additional surface and subsurface soil samples were collected during the Phase II field investigation to delineate the extent of metals and explosives contamination detected during the Phase I investigation and to further characterize the site. Metals, at concentrations exceeding background, and explosives were detected in both surface and subsurface soil. In addition, a detailed grid survey of SWMU 40 was conducted in November 1995 to characterize the types and distribution of debris on the surface of the SWMU and to evaluate the presence of additional UXO. Previously identified fragments of rocket and artillery propellant were also further characterized in 1995. The results indicate that specific areas

within the SWMU have a high density of debris, including seven items of UXO that were identified, flagged, and destroyed by TEAD AED personnel in place. From the soil samples collected within SWMU 40, arsenic, barium, lead, HMX, RDX, and 1,3,5-trinitrobenzene were identified as COPCs for the quantitative human health risk assessment. Estimated risks to human health for all the scenarios evaluated are within or below the USEPA criteria. One location was evaluated as a "hot spot" because of elevated concentrations of the explosive RDX. The hot spot evaluation results indicate that there are no current unacceptable risks associated with the RDX. Carcinogenic risks and noncarcinogenic hazards for the future on-site residents (adult and child) exceed USEPA risk-based criteria (2.8E-03 and 3.0E-03, respectively) and goal of unity (22 and 35, respectively) primarily from the ingestion of RDX in hypothetical produce grown at the hot spot. For the remainder of SWMU 40, no unacceptable risks from COPCs were identified. On the basis of these results, no further RI field investigations appear to be warranted. Hot spot removal, based on the human health risk assessment, may be required. Physical risks from UXO remain at SWMU 40. The need for remedial action will be assessed further as part of the FS. Any activity conducted at SWMU 40 would first require a UXO survey to ensure worker safety. A covered trench, suspected to contain UXO, was not fully evaluated during the phase II RI due to safety concerns. Additional evaluation of this trench, utilizing qualified EOD personnel, is recommended during the FS process.

7.4 LEAD HAZARDS ASSOCIATED WITH SWMUs 6, 8, 23, 36, AND 40

Hazards associated with potential exposure to lead were evaluated for five SWMUs with average soil lead levels that exceeded the OSWER residential screening level of 400 mg/kg. These were:

- SWMU 6
- SWMU 8
- SWMU 23
- SWMU 36
- SWMU 40

At each SWMU, potential exposures to a resident child were evaluated. In addition, exposures to a site-specific laborer and construction worker were also evaluated. With the two exceptions discussed below, all scenarios were below acceptable levels.

At the request of EPA Region VIII, a subsurface lead "hot spot" within the northeast Revetment Area of SWMU 6 was investigated separately. The "hot spot" involved three data points with concentration ranging from 3,600 mg/kg to 17,000 mg/kg. Although the Bowers model used for the construction worker scenario requires a measure of central tendency as an input (e.g., arithmetic mean, geometric mean), the number of data points is too small to derive a meaningful estimate of a mean. Therefore, the maximum (17,000 mg/kg) and minimum (3,6000 mg/kg) values were separately used as inputs to the Bowers model for both the RME and CTE construction worker scenarios.

As one might expect when using a single value as a constant EPC, the resulting blood lead levels exceeded the reference value. RME construction worker levels range from 20 μg Pb/dL blood to 110 μg Pb/dL blood. CTE construction worker scenarios ranged from 7 μg Pb/dL blood (below the 11.1 μg Pb/dL blood target level) to 24 μg Pb/dL blood.

At SWMU 8, lead concentrations from the Bullet Stop Area result in child residential blood lead levels that exceeded the target level of 10 μg Pb/dL blood by approximately a factor of 2. The primary contributing pathway was ingestion of home-grown fruits and vegetables. The transfer factors from soil to plants used in the uptake model (Baes et al. 1984) are conservative and have, in some instances, been shown to overestimate concentrations in plant tissue by as much as an order of magnitude.

Both of these SWMUs are part of the land parcel at TEAD that will remain under the continuing mission of the installation. No residential redevelopment or industrial construction activities are planned for the foreseeable future. However, both SWMUs will be considered for possible removal actions during the FS process due to the future land use scenario hazards associated with lead in soils.

Table 7-1. Summary of Phase II RI Results, Conclusions, and Recommendations for OUs 4, 8, and 9 at TEAD

SWMU Name	SWMU Number	Contaminants Identified	Nature/Extent of Contamination	Risk Assessment Results	Conclusions and Recommendations
OU 4					
Former Transformer Boxing Area	31	SVOCs	SVOCs were detected in surface soils only. No subsurface samples were taken at this site. This area is currently being used as a parking area for vehicles. The SVOCs detected may be associated with fluid leakage from these vehicles.	Total PAHs were identified as COPCs at this site. Human health risks associated with this SWMU are within or below USEPA criteria.	No unacceptable human health risks were identified at SWMU 31. No further remedial investigations are recommended. An FS will be conducted, as required by CERCLA.
PCB Spill Site	32	metals and SVOCs	Metals and SVOCs in surface and subsurface soil.	Arsenic, cadmium, and chromium were identified as COPCs in soils. Risks to human health are below USEPA criteria.	No unacceptable human health were associated with the COPCs identified at this site. No further remedial investigations are recommended. An FS will be conducted, as required by CERCLA.
Wastewater Spreading Area	35	pesticides and metals	Pesticides and metals in surface and subsurface soil. No analytes exceeding MCLs detected in groundwater samples.	Arsenic, delta-benzenehexachloride, alpha-chlordane, gamma-chlordane, endrin, heptachlor and heptachlor epoxide were identified as COPCs. All scenarios except future resident adult and child fall within or below target ranges for ILCRs and HIs. Future resident risk estimates are near the upper bound for acceptable carcinogenic risk. Non-carcinogenic hazards exceed the goal of unity for the future residents at the Stable Area.	Estimated human health risks were at acceptable levels except for noncarcinogenic hazards associated with the future resident in the Ditches West of the Stable Area. No further remedial investigations are recommended. An FS will be conducted, as required by CERCLA. The Stable Area east of the SWMU 35 boundary is now part of the BRAC parcel and will likely be evaluated in the FS separately from the remainder of the SWMU.

Table 7-1. Summary of Phase II RI Results, Conclusions, and Recommendations for OUs 4, 8, and 9 at TEAD (continued)

SWMU Name	SWMU Number	Contaminants Identified	Nature/Extent of Contamination	Risk Assessment Results	Conclusions and Recommendations
OU 8					
Old Burn Area	6	metals and explosives	Metals and explosives were found in both surface and subsurface soil. Buried metal debris was found in a number of test pits. RDX was detected in only one subsurface soil sample. Dioxins/furans were detected in low concentrations throughout the SWMU 6 area and in background samples collected away from the SWMU indicating that the contaminants may be anthropogenic. Comparison with risk-based criteria indicated that dioxins/furans should not be retained as COPCs.	Aluminum, antimony, arsenic, chromium, copper, iron, lead, thallium, zinc, and 1,3,5-trinitrobenzene were the COPC identified in both surface and subsurface soils. Risks to human health are below USEPA criteria except for noncarcinogenic hazards in the Revetment Area for the future adult and child resident primarily from ingestion of produce.	Estimated human health risks were at acceptable levels with the exception of the future resident through ingestion of produce and the construction worker from exposure to lead (hot spot in revetment). No further remedial investigations are recommended. An FS will be conducted, as required by CERCLA. Further evaluation of trench areas would be required prior to any future construction activities at SWMU 6. This will be reflected in the FS.
Chemical Range	7	metals and SVOCs	Metals detected in surface and subsurface soil. The only significant concentrations were detected in the immediate vicinity of the bullet stop. A few traces of SVOCs detected. Metal debris encountered during sampling.	Aluminum, arsenic, beryllium, manganese, and thallium were reatined as COPCs. Risks to human health under all of the evaluated scenarios are within or below USEPA criteria except for the future adult and child resident in the Northeast Test Area Trench and the Bullet Stop Area. HIs for the future construction worker at the Northeast Test Area Trench also exceeded criteria.	Estimated human health risks under current scenarios were found to be acceptable except the off-site child resident (HI exceeding one). Future scenarios were found to be acceptable except for noncarcinogenic hazards to the future resident and construction worker in the Bullet Stop and Northeast Test Area Trench. No further remedial investigations are recommended. An FS will be conducted, as required by CERCLA. Emphasis during the FS should be placed on evaluating options for the open trench in the northeast portion of the SWMU. TEAD has submitted plans for a voluntary removal action at the open trench.

Table 7-1. Summary of Phase II RI Results, Conclusions, and Recommendations for OUs 4, 8, and 9 at TEAD (continued)

SWMU Name	SWMU Number	Contaminants Identified	Nature/Extent of Contamination	Risk Assessment Results	Conclusions and Recommendations
Tire Disposal Area	13	metals, SVOCs, and VOCs	Mercury, lead, and chromium in surface soil. SVOCs and VOCs in low concentrations in surface and subsurface.	Chloromethane and diethyl phthalate were the COPCs identified at this site. Risks to human health are within or below USEPA criteria.	No human health risks exceeded USEPA risk-based criteria. No further remedial investigations are recommended. An FS will be conducted, as required by CERCLA.
Building 1303 Washout Pond	22	metals and explosives	Metals and explosives in surface and subsurface soils. All explosive contamination was detected in the discharge and ponding area of this site. Metals detections above background were primarily on the surface throughout the site.	COPCs retained for SWMU 22 were chromium, 1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, and RDX. Risks to human health under current scenarios are below USEPA criteria for carcinogenic risks but exceed the noncarcinogenic criteria primarily from the ingestion of explosives in soil. Future scenarios also had noncarcinogenic hazard indices exceeding unity.	Estimated carcinogenic human health risks were found to be acceptable. However, noncarcinogenic hazards were found to exceed USEPA criteria in current and future scenarios. No further remedial investigations are recommended. An FS will be conducted, as required by CERCLA. Remediation of the small area of explosives contamination in the drainage and ponding area is warranted. TEAD has submitted plans for a voluntary removal of contaminated soil at SWMU 22.

Table 7-1. Summary of Phase II RI Results, Conclusions, and Recommendations for OUs 4, 8, and 9 at TEAD (continued)

SWMU Name	SWMU Number	Contaminants Identified	Nature/Extent of Contamination	Risk Assessment Results	Conclusions and Recommendations
Bomb and Shell Reconditioning Building	23	cyanide, metals, SVOCs, and PCBs	Metals were detected above background and SVOCs were detected throughout the site but were concentrated in the stained areas associated with the outfall discharge areas. Cyanide and PCBs detected within the stained soils near the outfall discharge areas.	Cadmium, chromium, lead, anthracene, phenanthrene, pyrene, PCB 1248, total PCBs, and total PAHs in soil were the identified COPCs. Current risks to human health are within or below USEPA criteria. Future carcinogenic risks exceed USEPA criteria for the adult and child resident in the Asphalt and Stained Area primarily from ingestion of homegrown produce. Noncarcinogenic hazard indices for the future child resident exceed criteria in the Building 1345 Outfall Area.	Estimated current scenario human health risks were found to be acceptable. Future resident noncarcinogenic hazards exceed criteria in specific areas of concern containing staining. No further remedial investigations are recommended. An FS will be conducted, as required by CERCLA. It is recommended that "hot spot" removal be considered when evaluating this site for potential future remediation. Most future scenario risks appear to be associated with areas of surface staining. Also an evaluation of potential VOC contamination should be conducted during the FS process at SWMU 23.
Old Burn Staging Area	36	metals	Barium, chromium, copper, lead, and zinc in surface soil. Mercury in one subsurface sample. Contamination is minor and primarily associated with areas where burning was conducted.	Barium, copper, and lead were the COPCs identified at this site. No current unacceptable human health risks were found to be associated with this SWMU. A "hot spot" was identified and evaluated. Noncarcinogenic hazards for future residents were found to exceed the USEPA goal through ingestion of copper in soils.	No current scenario human health risks were identified. Noncarcinogenic hazards for the future resident exceed the regulatory goal. This is due to a hot spot related to former burning activities on the floor of the gravel pit. No further remedial investigations are recommended. A feasibility study will be conducted, as required by CERCLA.

Table 7-1. Summary of Phase II RI Results, Conclusions, and Recommendations for OUs 4, 8, and 9 at TEAD (continued)

SWMU Name	SWMU Number	Contaminants Identified	Nature/Extent of Contamination	Risk Assessment Results	Conclusions and Recommendations
OU 9					
Small Arms Firing Range	8	metals	Metals at concentrations exceeding background detected throughout the site with highest concentrations within bullet stop areas.	Aluminum, antimony, arsenic, chromium, copper, and lead were identified as COPCs soils. Risks to human health under current scenarios are below USEPA criteria. Noncarcinogenic hazards for future adult and child residents exceed the USEPA goal of unity within the Bullet Stop area of concern. In addition, child exposure to lead was also found to exceed USEPA criteria.	No current scenario human health risks exceed regulatory criteria. Removal of the lead hot spot in the Bullet Stop area of concern would likely reduce future scenario human health risks and risks to the environment to acceptable levels. No additional remedial investigation is recommended. An FS will be conducted, as required by CERCLA.
AED Test Range	40	metals, explosives, and SVOCs	Metals at concentrations exceeding background and explosives detected in the surface and subsurface. A few traces of SVOCs detected. A suite of chemicals associated with rocket and artillery propellants was analyzed for but results were inconclusive as to whether leaching of contaminants from propellant has occurred. Explosive Ordnance Waste and UXO are still present in former testing areas of SWMU 40.	Arsenic, barium, lead, HMX, RDX, and 1,3,5-trinitrobenzene were identified as COPCs. Current scenario risks to human health under all of the evaluated scenarios are within or below USEPA criteria. One location evaluated as an RDX hot spot indicated that noncarcinogenic hazards for future residents exceed the USEPA goal of unity.	Estimated human health risks under current conditions were found to be acceptable. The hot spot evaluation results indicate that is a future hazard to adult and child residents associated with the RDX. No further remedial investigations are recommended. An FS will be conducted, as required by CERCLA. Physical hazards in the form of UXO still exist at SWMU 40 as evidenced by the numerous projectiles and bomblets located during the Phase I and Phase II RI. The FS should consider these hazards when evaluating remedial alternatives for the site. Further evaluation of a trench containing suspected UXO is recommended utilizing qualified EOD personnel.

8.0 REFERENCES

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9.0 ACRONYMS AND ABBREVIATIONS

ACLDAN	alpha chlordane
AED	Ammunition Equipment Directorate
AENSLF	alpha-endosulfan
AG	silver
ALDRN	aldrin
ANAPNE	acenaphthene
ANAPYL	acenaphthylene
ANTRC	anthracene
AS	arsenic
ASTM	American Society for Testing and Materials
AUF	area use factor
BA	barium
BAANTR	benzo[a]anthracene
BAPYR	benzo[a]pyrene
BBFANT	benzo[b]fluoranthene
BBHC	beta-benzene hexachloride
BBZP	butylbenzyl phthalate
BE	beryllium
B2EHP	bis (2-ethylhexyl) phthalate
BENSLF	beta-endosulfan
BGHIPY	benzo[g,h,i]perylene
bgs	below ground surface
BKFANT	benzo[k]fluoranthene
BR	bromide
BRAC	Base Realignment and Closure
BZALC	benzyl alcohol
CAP	Corrective Action Permit
CD	cadmium
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CH3CL	chloromethane
CHRY	chrysene
CL	chloride
cm/sec	centimeters per second
CO	cobalt
CoC	chain of custody
COPCs	chemicals of potential concern
CR	chromium
CRLs	certified reporting limits
CSF	carcinogenic slope factor
CTE	central tendency exposure
CU	copper
CYN	cyanide

DANS	Data Acquisition Navigation System
DBAHA	dibenz[ah]anthracene
13DBD4	1,3-dichlorobenzene-D4
DBHC	delta-benzene hexachloride
DBZFUR	dibenzofuran
13DCLB	1,3-dichlorobenzene
DCLB	dichlorobenzene - nonspecific
DEP	diethyl phthalate
DLDRN	dieldrin
DMP	dimethyl phthalate
DNBP	di-n-butyl phthalate
24DNT	2,4-dinitrotoluene
26DNT	2,6-dinitrotoluene
DPA	diphenylamine
DQA	Data Quality Assurance
DQST	Data Quality Screening Tool
EA	EA Engineering, Science, and Technology, Inc.
EDA	Economic Development Association
EDC	Economic Development Conveyance
ENDRN	endrin
ENDRNA	endrin aldehyde
ENDRNK	endrin ketone
EODT	EOD Technologies, Inc.
EPC	exposure point concentration
ESFSO4	endosulfan sulfate
FANT	fluoranthene
FE	iron
FF	foraging area factor
FFA	Federal Facility Agreement
FLRENE	fluorene
FS	Feasibility Study
GCLDAN	gamma-chlordane
GC/MS	gas chromatography/mass spectroscopy
GFAA	graphite furnace atomic absorption
GPS	Global Positioning System
HEAST	Health Effects Assessment Summary Table
HG	mercury
HI	hazard index
HMX	cyclotetramethylenetetranitramine
HPCL	heptachlor
HPCLE	heptachlor epoxide
HQ	hazard quotient
ICDPYR	indeno [1,2,3-c,d] pyrene
ICP	inductively coupled plasma
IEUBK	Integrated Exposure Uptake Biokinetic

IF	ingestion rate
ILCRs	incremental lifetime cancer risks
IRDMIS	Installation Restoration Data Management Information System
IRIS	Integrated Risk Information System
IWTP	Industrial Waste Treatment Plant
JMM	James M. Montgomery
LCS	laboratory control sample
LIN	lindane
LOAEL	lowest-observed-adverse-effect-level
m/yr	months per year
MCLs	maximum contaminant levels
MDL	method detection limit
mg/g	milligrams per gram
μg/g	micrograms per gram
MN	manganese
2MNAP	2-methylnaphthalene
MS/MSDs	matrix spike/matrix spike duplicates
MVU	minimum variance unbiased
NI	nickel
NNDPA	n-nitrosodiphenylamine
NO2	nitrite
NO3	nitrate
NOAEL	no-observed-adverse-effect-level
NPL	National Priorities List
OD	outside diameter
OSHA	Occupational Safety and Health Administration
OUs	operable units
PAHs	polycyclic aromatic hydrocarbons
PB	lead
PCB248	polychlorinated biphenyl 1248
PCB254	polychlorinated biphenyl 1254
PCBs	polychlorinated biphenyls
PHANTR	phenanthrene
PID	photoionization detector
PO4	phosphate
PP	Proposed Plan
PPDDD	1,1-dichloro-2,2-bis(para-chlorophenyl)ethane
PPDDE	2,2-bis(para-chlorophenyl)-1,1-dichloroethene
PPDDT	2,2-bis(para-chlorophenyl)-1,1,1-trichloroethane
ppm	parts per million
PQL	practical quantitation level
PRGs	preliminary remediation goals
PYR	pyrene
QAP	Quality Assurance Plan
QA/QC	quality assurance/quality control

RA	risk assessment
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RDA	recommended daily allowance
RDX	cyclonite
RDX	cyclotrimethylenetrinitramine
RfD	reference dose
RFI	RCRA Facility Investigation
RI/FS	Remedial Investigation/Feasibility Study
RIA	Remedial Investigation Addendum
RMA	Rocky Mountain Arsenal
RME	reasonable maximum exposure
ROD	Record of Decision
RPD	relative percent difference
Rust E&I	Rust Environment and Infrastructure
SB	antimony
SCS	Soil Conservation Service
SE	selenium
SO4	sulfate
SOPs	standard operating procedures
SQL	sample quantitation limit
SSLs	soil screening levels
SVOCs	semi-volatile organic compounds
SWMUs	solid waste management units
TAL	target analyte list
TBVs	toxicity benchmark values
111TCE	1,1,1-trichloroethane
TCEDC	Tooele County Economic Development Corporation
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TEAD	Tooele Army Depot
TEAD-N	Tooele Army Depot-North
TEAD-S	Tooele Army Depot-South
TEF	toxicity equivalency factor
TETRYL	n-methyl-n 2,4,6-tetranitroaniline
TI	titanium
TICs	tentatively identified compounds
135TNB	1,3,5-trinitrobenzene
246TNT	2,4,6-trinitrotoluene
TSCA	Toxic Substances Control Act
UCL	upper confidence limit
UDEQ	Utah Department of Environmental Quality
USAEC	U.S. Army Environmental Center
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
USEPA	U.S. Environmental Protection Agency

UST	underground storage tank
UXO	unexploded ordnance
V	vanadium
VOCs	volatile organic compounds
ZN	zinc